Factory

MANAGEMENT *and* MAINTENANCE

OIL cost fits snugly into its proper column: LUBRICATION stretches 'way across the cost sheet . . . If it's CORRECT LUBRICATION it *cuts* other costs — power costs, maintenance costs, repair costs. Oil cost hasn't anything to do with these *real* cost effects of lubrication.

Operating costs are *totaled* before they acquire profit and loss significance. By that time nobody cares what the *oil* cost. But if something has cut costs all along the line—that's news! CORRECT LUBRICATION can. You can buy it.

It involves expert survey of equipment, operating conditions, methods of lubricant-application—work for Standard Oil Lubrication Engineers. It costs nothing to *find* the economies of CORRECT LUBRICATION. It has nothing to do with the cost of oil. ··· Simply write the nearest office of the Standard Oil Company (Ind.)

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The FACTS regarding the savings effected by Standard Oil lubrication engineers (50%—54%—77% of former lubrication costs!) are leading more and more *cost-minded* executives to avail themselves of this advisory service.

STANDARD OIL COMPANY (INDIANA) SERVICE

NRA WE DO OUR PART

STANDARD OIL COMPANY

910 S. MICHIGAN AVE. (INDIANA) CHICAGO, ILLINOIS

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Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

MAY • 1934

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FOR *Low Cost*
HEAVY DELIVERY SERVICE
YOU NEED THE DEPENDABILITY OF Firestone TRUCK TIRES

THE Air Reduction Sales Co. operate their fleet of trucks on schedules that must be maintained. Road delays had to be eliminated so they equipped their fleets of trucks with Firestone Tires. Safety Protected *on the Inside* with Gum-Dipped High Stretch Cords, and Safety Protected *on the Outside* with deep cut, scientifically designed tread that grips and holds the road, Firestone Tires withstand the abuses and punishment of heavy delivery service and give lowest cost per mile.

See your nearby Firestone Service Dealer or Service Store today and equip your fleet with a new set of Firestone Truck Tires. Have him install a new Firestone Battery and a new set of Firestone Spark Plugs—Reline your brakes with the new Firestone Aquapruf Brake Lining. Firestone extra value products will save you time and money.

Specify Firestone Tires and Rims on Your New Trucks

Listen to Lawrence Tibbett or Richard Crooks and Harvey Firestone, Jr., every Monday night—N.B.C. Network

FIRESTONE TIRES WILL REDUCE *Your* OPERATING COSTS

Copyright, 1934, The Firestone Tire & Rubber Co.

FACTORY MANAGEMENT and MAINTENANCE

MAY, 1934

Don't take that job unless you know its cost

Formulas can predict accurate labor costs on jobbing work

G. J. Stegemerten

Superintendent of Time Study
Westinghouse Electric and Manufacturing Company
East Pittsburgh, Pa.

IN THESE days of operation under codes of fair competition, it is becoming more and more essential for industry to know more accurately the cost of manufacturing its products. Costs based upon averages, which often means that standard lines and the simpler work are costed too high, while special orders and more complex jobs are costed too low, are no longer sufficient. On every hand is seen the necessity for greater efficiency and reduced unit costs to offset the additional burden of increases in labor rates and overhead expenses. Intelligent procedure in this direction is dependent upon accurate standard costs. Manufacturers basing costs on averages instead of accurate standards are quite likely to find themselves receiving orders for all the complicated work upon which they bid, while their competitors who have accurate costs based on actual labor and material are awarded all of the simpler work.

Accurate costs can be obtained only if the amount of labor necessary to make each job can be measured. The possibility of doing this in factories handling a standard line of work has been widely recognized. Detailed time studies are taken on each operation of each job, and are used not only in connection with an incentive system but also for determining costs.

That the same can be done on work of a jobbing nature is not so generally recognized. At first glance it appears impracticable because of the work involved in establishing time standards. In a plant handling a standard line of work, one time study will often lead to the establishment of a time value covering the work of several operators for months or even years. In jobbing work, a time value may cover a job which lasts only ten minutes. The temptation is to arrive at averages by collecting data over a representative period and establishing values based entirely upon the weight of some other general characteristic. This procedure is not only inaccurate, it is dangerous, and may lead to the taking of more unprofitable than profitable work.

Neither Mysterious nor Academic

But it is not necessary to take time studies of each individual job in order to establish accurate and consistent time values. Instead, it is possible to derive formulas that will enable one to do this quickly and easily. A formula is nothing mysterious or academic; it is merely a convenient way of expressing the manner of variation between two or more interdependent variables. When all but one of the variable quantities are known for a given set of conditions, it is quite easy to find the unknown quantity by substitution in and solution of an algebraic formula.

More specifically, the unknown is the time for doing the operation according to the variable factors. The process can be more clearly illustrated by examples;

FILE THIS ISSUE FOR FUTURE REFERENCE

USER'S DATA ON USS PLYKROME

USS PLYKROME is available in these sizes:

Maximum Width of Plate	72 inches
Maximum Length of Plate	24 feet
Minimum Thickness	⅛ inch
Maximum Thickness	⅝ inch
Thickness of Stainless Steel Veneer	
On plates ¼ inch thick or heavier	.030 inch or .060 inch
On plates lighter than ¼ inch	.030 inch
Stainless Veneer is USS Stabilized 18-8	
Backing Plate is Low Carbon Steel	
Standard Finishes Available: Sand blast	

For data on lighter weights or special finishes write Illinois Steel Company.

CORROSION RESISTANCE . . . . . .

On its stainless face, PLYKROME is completely inert under all natural atmospheres containing the usual traces of corrosive gases and moisture.

It is also resistant to the corrosive action of a wide variety of chemicals and of by-product reagents and raw materials. While service tests should determine the performance of PLYKROME under actual conditions, the following list will indicate the wide variety of media to which PLYKROME is highly resistant:

- Acetic Acid cold, at any concentration; hot, up to 10%
- Alkaline Solutions including Ammonium Hydroxide
- Bichloride of Mercury in usual antiseptic strengths
- Carbolic Acid
- Carbonated Water
- Citric Acid cold, moderate strength
- Copper Sulphate
- Fruit and Vegetable Juices
- Hydrogen Peroxide
- Fermented or Distilled Drinks
- Hydrogen Sulphide
- Laundry Solutions with few exceptions
- Milk and Dairy Products
- Nitric Acid
- Photographic Solutions
- Salt Solution
- Sea Water
- Sulphuric Acid cold, very slight action
- Sulphurous Acid
- Wood Pulp
- Yeast
- Zinc Chloride. cold
- Zinc Sulphate

FABRICATION FACTS . . . . . .

PLYKROME generally may be worked in accordance with the usual methods and with the same equipment as employed on ordinary carbon steels. It may be:

Welded — Formed Hot — Deep Drawn — Beaded — Cold Rolled

PLYKROME does not oxidize at elevated temperatures once a thin adherent scale is formed. It scales comparatively little below 1600 to 1650 degrees F.

Because its Stainless Steel surface has been stabilized, PLYKROME does not require annealing following welding or hot forming, to preserve its corrosion resistant qualities. This is of particular importance on those products which cannot be heat-treated after fabrication.

USS PLYKROME

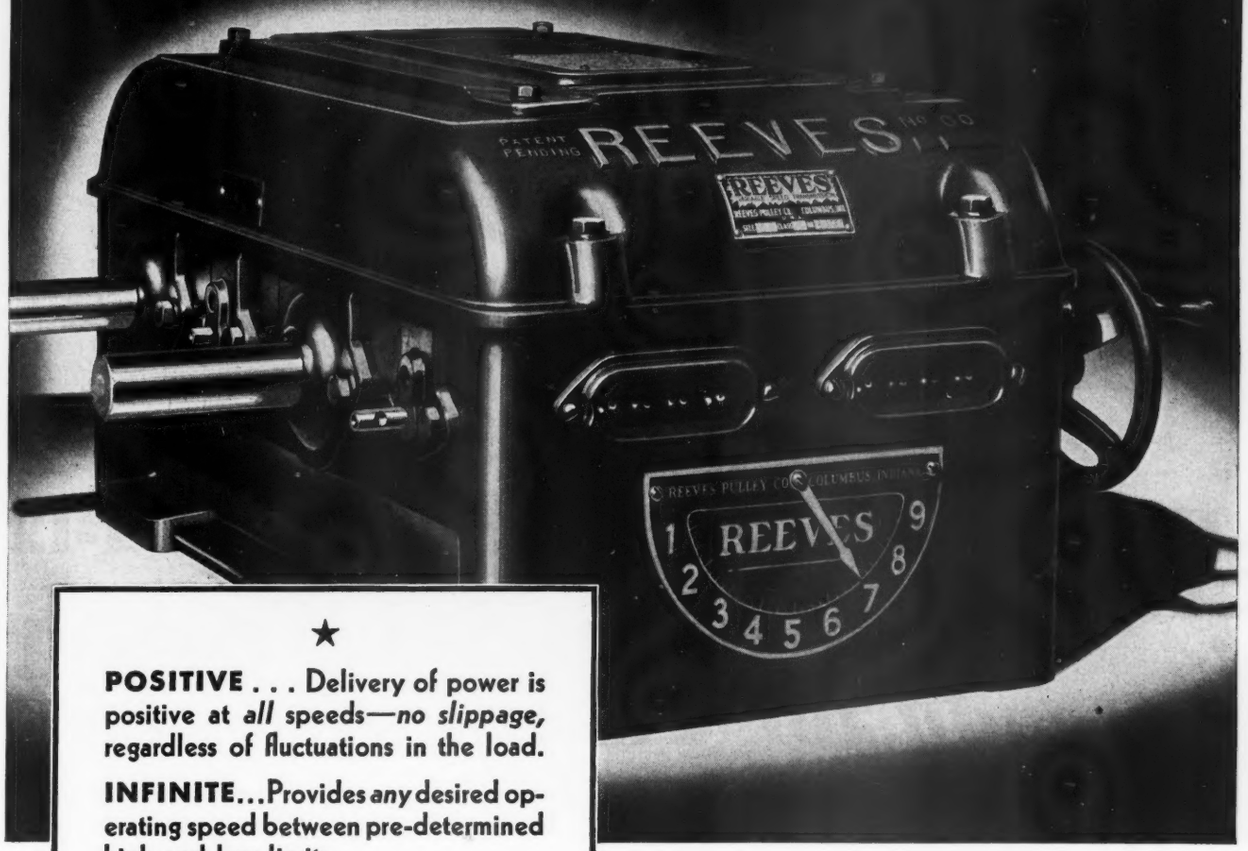
Illinois Steel Company

208 SOUTH LASALLE STREET, CHICAGO, ILLINOIS

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

U S S CHROMIUM-NICKEL ALLOY STEELS ARE PRODUCED UNDER LICENSES OF THE CHEMICAL FOUNDATION, INC., NEW YORK, AND FRIED. KRUPP A. G. OF GERMANY

REEVES COMBINES *all* ★ THESE ESSENTIAL FEATURES



★

POSITIVE . . . Delivery of power is positive at *all* speeds—*no slippage,* regardless of fluctuations in the load.

INFINITE...Provides *any* desired operating speed between pre-determined high and low limits.

ACCURATE . . . Absolute *precision* in speed selectivity—even to fractions of r.p.m.

WIDE-RANGE...*Correct* sizes, designs, speed ratios and controls for *all* requirements.

COMPACT...Horizontal and vertical models (unit motor mounting optional) *save space.*

PROVED...*Verified* by 80,000 installations; *endorsed* by builders of 900 different REEVES-equipped machines.

NATION-WIDE...*Engineering facilities* throughout U. S., Canada, and many foreign countries.

ORIGINATORS of the variable speed transmission and leaders in the *specialized field* of industrial speed regulation, REEVES engineers have devoted many years to making the REEVES Variable Speed Transmission the highly perfected unit it is today. . . . *Every feature* of the REEVES Transmission—including basic design and construction—has been *time-tested* in exacting service. *All* of the many REEVES improvements have come from *practical,* not theoretical, knowledge. . . . A REEVES Transmission between *any* production machine and its source of power is *complete protection* against the costly waste of inaccurate, inflexible speeds. Easily and economically installed. Write REEVES engineers for facts on any type application.

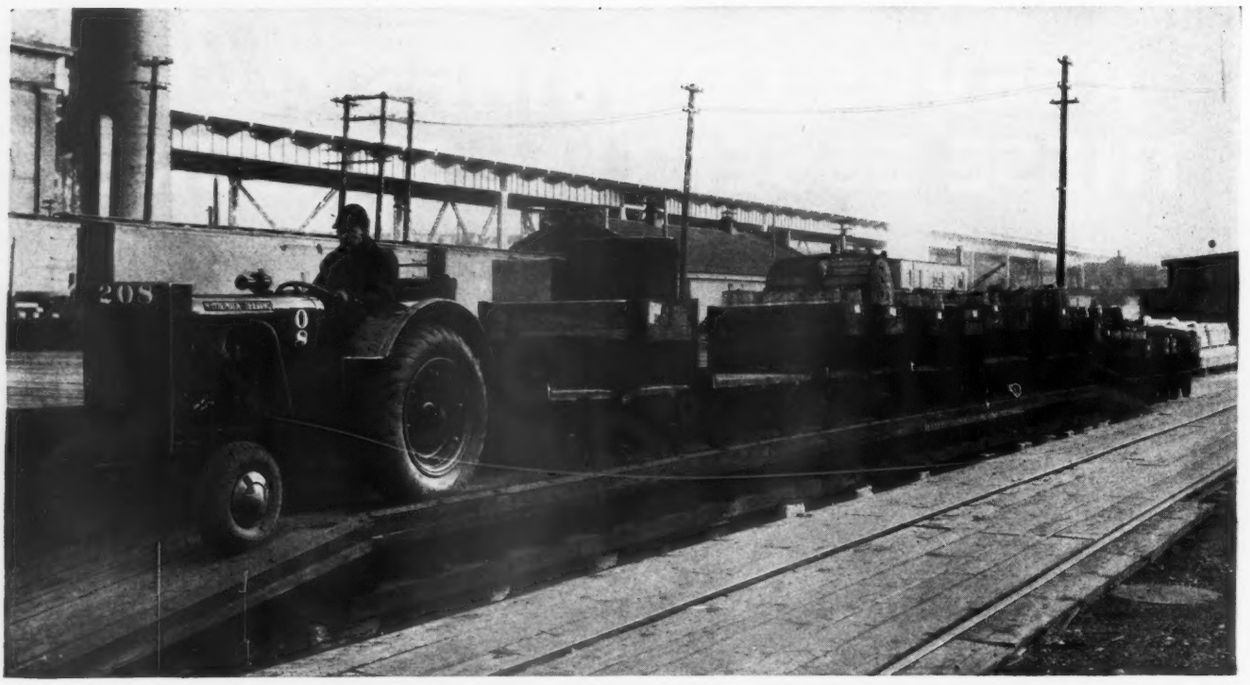
REEVES PULLEY COMPANY, Columbus, Ind.
Please send copy of Catalog F-99, containing 74 pages of valuable information on industrial speed regulation. 5-34

Name.....

Company.....

Address.....

City.....*State*.....



The Chicago, Milwaukee, St. Paul, and Pacific R. R. Co. uses this McCormick-Deering I-12 Industrial Tractor in its shops at Milwaukee. It is a simple job for this tractor to pull from twelve to eighteen trailers, such as shown here, holding two skids each. Trailers are loaded with brake shoes, rail spikes, lumber, fuel, lubricants, and various other materials.

The McCormick-Deering Model I-12
A Small Industrial Tractor
Ready for Plenty of Work

HERE is something new in an industrial tractor—the small, compact McCormick-Deering Model I-12—the only one of its kind on the market. It is just the type of unit that has long been needed for industrial work. Although small and economical, the I-12 features heavy-duty construction which provides great strength. It is mounted on large low-pressure tires. It has plenty of power and speed, and its short turning radius enables it to work in close quarters.

The application of the McCormick-Deering I-12 is extensive. Factories and railroads are finding use for it in inter-plant hauling, speeding materials and stores from building to building, from shop to loading platform, "spotting" cars, handling baggage and mail to and from trains, and on a variety of other work. The longer the I-12 is on the job, the more work you will find for it to do.

Get acquainted now with the Model I-12. The nearest Company-owned branch, or McCormick-Deering distributor or dealer, will give you information. Write us for catalogs.

There are four wheel-type tractors; three TracTracTors, including one with a Diesel engine; and four power units, including a Diesel power unit, in the McCormick-Deering Industrial Power line.

INTERNATIONAL HARVESTER COMPANY
OF AMERICA *(Incorporated)*
606 So. Michigan Ave. Chicago, Illinois

NRA WE DO OUR PART

THERE IS SOMETHING ABOUT

"3-POINT SERVICE"— WILL YOU TAKE LESS?

(1) The right kind of CRUDE is important. Some types are better adapted to certain uses than others. Pure Oil Crude comes from many fields in nine states, not from a single area producing only *one* kind of Crude that must be recommended and sold for *every* lubrication need.

(2) Good REFINING is vital. No commercially practical refining process can add missing properties to inferior crudes. But even the best Crude must be correctly Refined to prevent loss of inherent lubricating values. Pure Oil modern Refining methods preserve and *improve* the lubricating qualities of Pure Oil superior Crudes.

(3) Scientific APPLICATION is equally important. Good Crude and good Refining go for naught unless skilled engineering selects the best types of lubricant for the particular job in question. Pure Oil Engineers are not only lubrication experts, they have had extensive experience in practical plant operation problems.

"Three sheets in the wind," from clipper days . . . The three-leaved shamrock, old Erin's symbol . . . Three strikes and out, America's chance for a batter . . . And dozens more, each basic and packed with meaning . . .

Drop one or two of each combination and it means nothing. Buy oil and grease lacking one or two essentials, and you approach nothing.

Read about Pure Oil's "3-Point Lubrication Service" in the three brief paragraphs to the left. Compare "3-Point Service" with any other. Can't you buy more lubrication, and save more maintenance, with "3-Point Service"? You can find out very quickly: Ask a Pure Oil man to call.

The PURE OIL *Company*

PRODUCERS, REFINERS AND MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS

REFINERIES:

Marcus Hook, Pa. Heath, O. Toledo, O.
Muskogee, Okla. Midland, Mich.
Smith's Bluff, Texas Cabin Creek Jct., W. Va.

BRANCH OFFICES:

Chicago, Bethlehem, Philadelphia, Wilkes-Barre, Akron, Columbus, Cincinnati, Hamilton, Dayton, Canton, Scranton, Indianapolis, Minneapolis, St. Paul, Pittsburgh, Charleston, Marcus Hook, Wheeling, New York, Newark, N. J., Troy, Utica, Trenton, N.J. (B-951)

An Old Ledger Speaks

FIFTY YEARS AGO, in our Boston Office, a book-keeper sat on a high stool, pridefully recording each day's business in fine Spencerian penmanship. When his time-stained ledger recently came to light what a revealing story it told. A story of business and business methods of a half century ago, of firms famous then, but long since forgotten.

But, there is a brighter side to this ledger's tale. Leafing through its pages we found no less than 43 direct customers whose names are still on our books—who still buy Jenkins Valves with the same confidence that they did in 1885. Were it possible to locate the fifty year old records of all our offices we wonder how many more firms we would find who have relied upon Jenkins Valves for 50 years or more.

While Jenkins Valves do change in design and in variety of types from time to time, to keep pace with changing industrial needs, one thing is changeless—their intrinsic worth. Our long-time heritage of building to a plus standard of value is unwaveringly upheld. It is true today, as it was 70 years ago, that using Jenkins Valves is always an economy—never an extravagance.

Jenkins Iron Body Gate Valves will survive the most critical comparison with others of any make—just as they survive the test of hard service. Send for large cut-out that clearly shows Jenkins superior features of design and construction. Jenkins Iron Body Gate Valves are made in sizes from two inch to forty-eight inch.

Jenkins Bros

JENKINS BROS., 80 White Street, New York, N.Y.; 510 Main Street, Bridgeport, Conn.; 524 Atlantic Avenue, Boston, Mass.; 133 North Seventh St., Philadelphia, Pa.; 822 Washington Boulevard, Chicago, Ill.; JENKINS BROS., Ltd., Montreal, Canada; London, Eng.

JENKINS VALVES · SINCE 1864 · BRONZE · IRON · STEEL

They Think *and* Say

United Front

In the (automotive) settlement just accomplished, two outstanding advances have been achieved.

In the first place, we have set forth a basis on which, for the first time in any large industry, a more comprehensive, a more adequate, and a more equitable system of industrial relations may be built than ever before.

It is my hope that this system may develop into a kind of works council in industry in which all groups of employees, whatever may be their choice of organization or form of represntation, may participate in joint conferences with their employers and I am assured by the industry that such is also their goal and wish.

In the second place, we have for the first time written into an industrial settlement a definite rule for the equitable handling of reductions and increases of forces.

It would be ideal if employment in all occupations could be more generally stabilized, but, in the absence of that much desired situation, if we can establish a formula which gives weight to the human factors as well as the economic, social, and organizational factors in relieving the hardship of seasonal layoff, we shall have accomplished a great deal.

FRANKLIN D. ROOSEVELT

No Guessing

I say to you in all the sincerity at my command, that the works council plan is likewise a supplement to the Golden Rule—it is the device by which management may substitute for its best guess as to the desires of the employees the direct and certain voice of the chosen representatives of the employees, and, likewise, the employees may have available to them the voice and the counsel of the employer.

ARTHUR H. YOUNG
Vice-President, U. S. Steel Corporation

No High Prices

Neither higher wages nor increased material costs can force us to raise prices. I have found that higher wages do not mean increased costs, and if our material prices go too high we will start making our own. We are making a part of everything we use, and from this nucleus can readily expand to take care of any or all of our requirements if necessary.

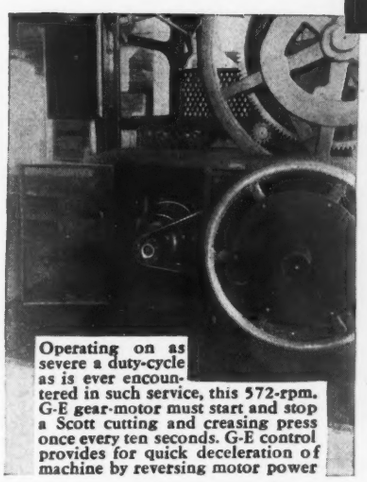
When prices go up, business goes down. I know that the emphasis is mostly the other way, but that is because we are ruled by the financial point of view and not the commodity point of view.

It is pretty certain that everybody will be looking for a plan to reduce prices be-

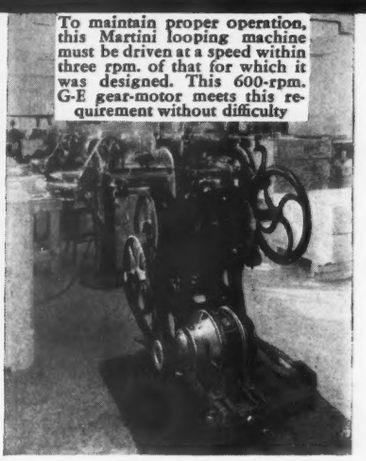
(Continued on advertising page 46)

HOW G-E GEAR MOTORS IN THIS MODEL PLANT . . .

- . . ADD CONVENIENCE
- . . REDUCE NOISE
- . . . . IMPROVE APPEARANCE
- . . . . SAVE SPACE



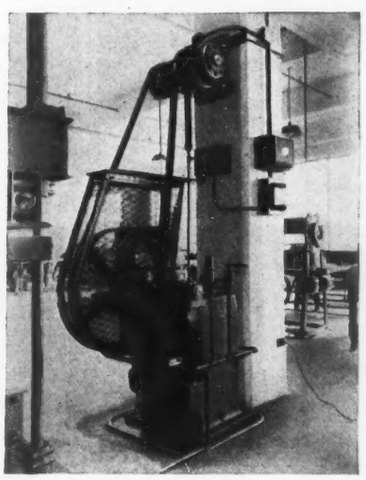
Operating on as severe a duty-cycle as is ever encountered in such service, this 572-rpm. G-E gear-motor must start and stop a Scott cutting and creasing press once every ten seconds. G-E control provides for quick deceleration of machine by reversing motor power



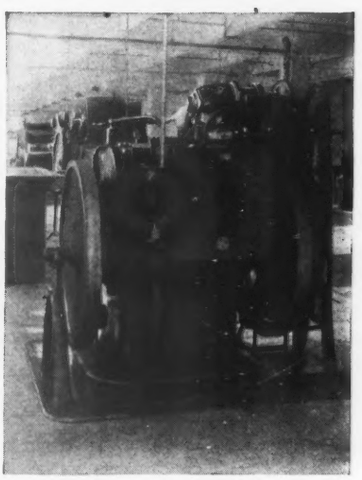
To maintain proper operation, this Martini looping machine must be driven at a speed within three rpm. of that for which it was designed. This 600-rpm. G-E gear-motor meets this requirement without difficulty

THE model layout of the National Card Mounting Company's plant in New York City provides an individual drive for each machine — with all motors mounted above floor level, conveniently accessible. Contributing materially to the fulfillment of this plan, are the four G-E gear-motor applications* shown at the right. They improve plant appearance; save space; and eliminate back-gearing, along with the noise it so often causes and the additional floor area it so often requires.

Each of these G-E gear-motors is a compact unit — a combination of a normal-speed motor and a built-in, helical planetary gear-reduction system running in oil to assure smooth, operation. Standard ratings are listed from 1/6 to 75 hp., and from 11 to 600 rpm. Other ratings can be supplied to meet the individual requirements of the driven equipment — whatever its characteristics may be.



Mounted conveniently out of the way, this 360-rpm. G-E gear-motor controlled by a G-E pressure governor provides power for a 75-ton hydraulic press. Despite its slow speed, this compact drive requires no countershafts



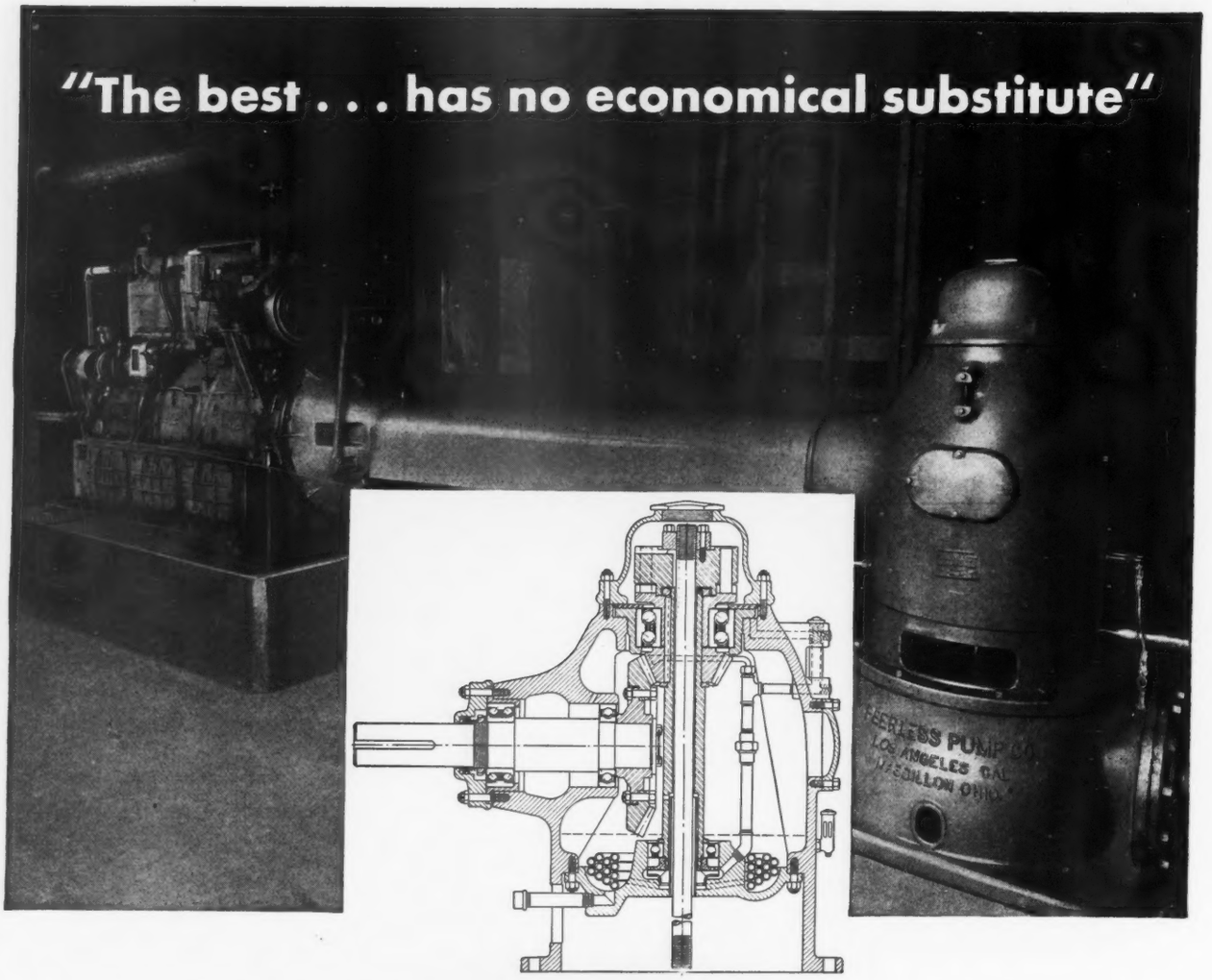
This compact 572-rpm. G-E gear-motor, mounted right on the machine, powers a Thompson cutting and creasing press requiring high starting torque. G-E preset speed control permits the operator to preset it . . . forget it

Your own low-speed drives can be equipped to advantage with G-E gear-motors. You will find them readily adaptable, simple to install, dependable in performance, smooth in operation, long in life — the kind of drive that will save you money. For complete information, address the G-E office nearest you; or write General Electric, Dept. 6E–201, Schenectady, N. Y.

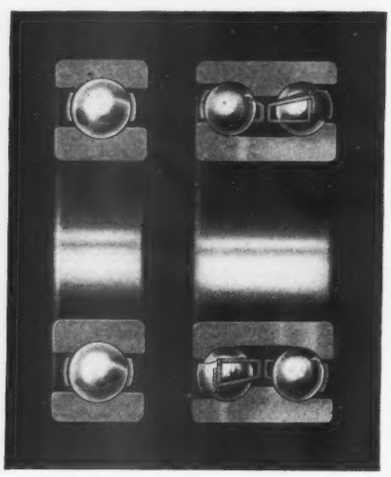
*Installed by Naumer Electric Company, a G-E Motor Dealer, New York City. The facilities of G-E Motor Dealers are at your command for every purpose requiring electric power.

010-1

GENERAL ELECTRIC



THE heavy thrust loads encountered in deep well pump service preclude the use of bearings with any weakness in design, materials or workmanship. » » » A never-failing water supply demands nothing but the best. The Peerless Pump Company picked New Departures on experience . . . users may be sure that if another bearing could carry on with greater satisfaction, Peerless would use it. They are sticklers for quality.



» » » The New Departure Double Row is unique in its ability to carry tremendous thrust and radial loads with minimum deflection. This is due to a special method of preloading the unit at assembly. » » » New Departures mean less wear, no adjustments and longer life. . . . . Ask for latest catalog just off the press. . . . The New Departure Mfg. Co., Bristol, Connecticut; Chicago, Detroit, San Francisco, London.

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

2116

FACTORY MANAGEMENT and MAINTENANCE

MAY, 1934

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Superintendent of Time Study
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More specifically, the unknown is the time for doing the operation according to the variable factors. The process can be more clearly illustrated by examples;

foundry operations will be used because industry in general is familiar with that class of work.

In foundry molding the variables are the size and shape of the pattern, amount of gating necessary, kind and number of cores and chills, and so on. The finished formula is based entirely upon common sense, and the least schooled molder or coremaker has no difficulty in seeing how the time for every operation is allowed for, once the formula is explained to him.

To construct a formula usually requires from one to four months, depending upon the experience of the time-study man in doing this type of work, records already available, and extent of poor conditions unearthed and corrected during the study. Once constructed, however, it quickly pays for itself, for it permits establishing accurate time values in from a few seconds to about two minutes, depending upon the complexity of the job.*

All foundry work consists primarily of five major operations: (1) make cores; (2) mold; (3) melt and pour metal; (4) shake out; (5) clean casting. All other operations, such as get and mix sand, line ladles and furnaces, transport materials, etc., are secondary, contributing directly or indirectly to the major operations, and the time for them may be included in the formula expressions for the main operations.

The first operation, make cores, is affected by more variables than the other operations, and it will therefore be worth while to consider it in some detail to show that it is entirely feasible to establish time values by formula.

Variables Affecting Coremaking Time

Cores are made in three general ways: on the bench; on the floor; by machine. It will prove most satisfactory to construct a separate formula for each class of work. In the jobbing foundry there is likely to be a preponderance of bench work, so the formula for bench coremaking will be discussed.

What are the variables that affect the time required to make a core on the bench? First, there is the general nature of the core itself, whether it is simple and chunky or complex with weak sections. The nature of the core does not affect all operations, but does affect some and must be considered.

*For a step-by-step exposition of the procedure followed in deriving formulas, see "Time and Motion Study and Formulas for Wage Incentives," Lowry, Maynard & Stegemerten. McGraw-Hill Book Company, 1933.

The volume of sand in the core will affect the time required to fill the box with sand and peen; the greater the volume, the greater the time required. But if a curve of volume against time is plotted from the data secured by studying this operation on a number of cores of varying size and shape, it will be found that the points do not line up in anything like a smooth curve, showing that another variable enters. A little analysis reveals that the relation between height and thickness of core also affects the time. Where the thickness is great compared with height, all sand may be put into the box and peened at one time. Where the thickness is small compared with height, sand must be put in a little at a time and peened frequently.

Filling and Peening

There are several ways of expressing the relationship among three interdependent variables—in this case volume, ratio of height to thickness, and time—and the choice of which one to use will depend upon a number of conditions. Without going into all of the reasons, it will be sufficient to say that the use of two curves in conjunction with each other was found best to fit the

▶ **Foundry work, because most of us are familiar with it, has been chosen to illustrate the use of formulas in determining labor costs. Coremaking happens to offer the most difficulty in constructing the formulas, so is discussed here in detail**

▶ **It may take three or four months to collect enough data for a formula. But once you have it, it is necessary only to sketch the core box and apply the formula to the variables. Result, a cost that will differ only slightly, if at all, from the actual cost should the job be performed**

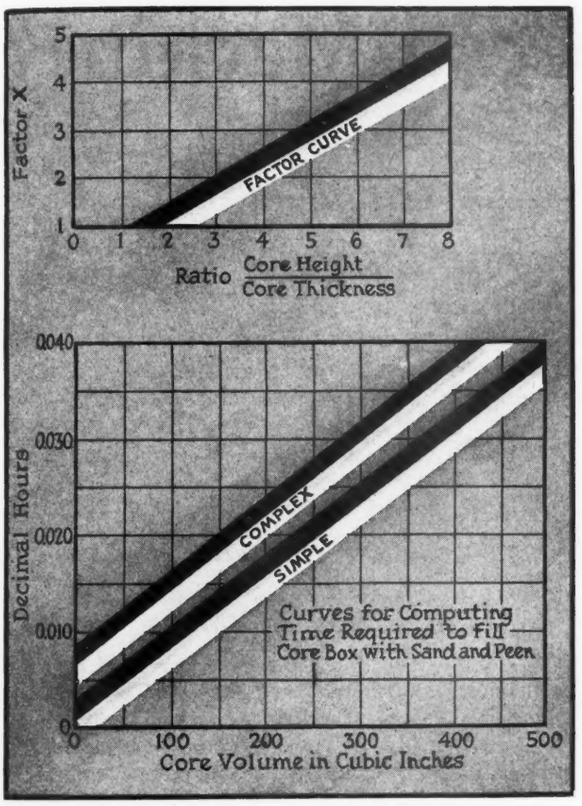

Factor X
FACTOR CURVE
Ratio Core Height / Core Thickness
Decimal Hours
COMPLEX
SIMPLE
Curves for Computing Time Required to Fill Core Box with Sand and Peen
Core Volume in Cubic Inches

Figure 1. The greater the volume, the more time required. But the relation between height and thickness of core determines how many peenings. Hence the need to multiply basic time by a figure representing that ratio. The figure is obtained from the upper curve

Mr. Stegemerten goes on in the June half of his article to consider other molding variables, then takes a single casting and shows how formulas used daily in his own company's foundry enable the time-study man to determine labor costs accurately

case in hand. The curves were plotted as shown in Figure 1. To find the time required to fill and peen a given core box, the ratio of height to thickness as determined by actual measurement of the box or the core is first computed. From the upper curve, a factor X is obtained. The basic time for the operation is read on the proper one of the two lower curves, the volume being obtained either by measurement of the core box or by weighing the completed core and converting weight to cubic inches. Basic time multiplied by X gives true time.

Other variables affecting coremaking time are:

(a) Core volume alone, which influences the time to rap and draw box, repair damage to core, get and prepare sand, brush box, file baked core, and blacken core by dipping.

(b) Box area, which affects time required to move box to set-off table.

(c) Strike area, or the area of the opening through which the box is filled with sand, which affects ramming, striking, and venting time, and time for gluing two half-cores together.

(d) Projected area of the core, which determines the number of cores that can be set on one drying plate and hence transportation time.

(e) Surface area, which, in conjunction with a classification of smooth surfaces and surfaces with projections, influences the time required for blackening the core with a brush.

(f) Miscellaneous variables, such as loose pieces in the core box, chills, nails, clamps, or characteristics which make the use of bedding sand necessary.

To Obtain Final Time Value

All these variables, with the possible exception of the volume of very complex cores, may be quickly determined by inspection and measurement of the core box; and even the volume of complex cores can be determined quite rapidly and accurately after a little practice in dividing the box into geometrically regular figures, such as rectagons, cylinders, cones, and so on, and summing up the volumes thus computed. When all variables have been measured and listed, coremaking time can be determined by substituting in the formula.

The final time value obtained from the formula can be made to include not only time required for performance of operations directly affected by the variables measured, but also all constant operations which occur regardless of size, shape, or complexity. Further, by means of percentages, allowances for delays, fatigue, normal core breakage, the excess number of cores made to allow for breakage between the core storage and the molder, and extra work caused by old and defective core boxes can also be included in the time-value.

If the coremaking work is done on the group plan, the time value can be made to cover the indirect labor that contributes to coremaking, such as the work of the laborer who gets and prepares sand, sweeps the floor, and grinds up broken cores, and that of the checker who runs the core storage. In short, the time value can be made to include time for every operation that goes directly or indirectly to the making of the finished core. The exact manner of doing this will depend upon the nature of the work, the procedure followed in working, whether group or individual incentives are used, and so on; but, regardless of conditions, a formula that will permit quick and accurate time values can be made.

As a result of being able to determine the amount of labor necessary to make each core, coremaking costs may be determined to the exact fraction of a cent. Furthermore, the formula will be invaluable in preparing estimates on new work. If a formula is available, it is necessary only to make a sketch of the core box required and apply the formula to the variables determined from the sketch. The result will be a time value and hence a cost that will differ, if at all, only very slightly from the actual cost of the job if it is performed.

Should I Buy Special Machines?

Yes *and* No *cases out of the woodworking industry*

Carl Endlein, Jr.

Endlein Engineering Corporation
New York, N. Y.

THE DESIGN and the building of specialized manufacturing equipment, such as production machinery made for the purpose of continually turning out one product, present problems which test not only the ingenuity of the design engineer but also the judgment of the production engineer. In order that the machinery builder may convince the product manufacturer of the soundness of making a capital investment in the replacement of old equipment, and in order that he may build equipment of a special nature which will fulfill requirements to the best possible advantage, he must be in full possession of the facts. To give the product manufacturer the greatest value for his investment of capital, the designer and builder of special manufacturing equipment must consider the following items:

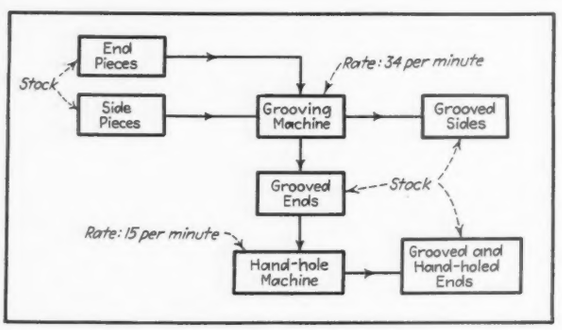


Figure 1

1. Economical cycle of operations.
2. Time element.
3. Handling of work in process.
4. Production cost.
5. Percentage of operating activity.
6. Capital investment.
7. Time required for self-payment.
8. Rate of net profit return.

Two concrete examples will serve to illustrate this statement. Case I will present the advantage of replacing the old equipment. Case II will demonstrate that more than doubling the required production does not necessarily justify doubling the amount of equipment and using the same order of manufacture in two lot quantities.

A manufacturer of wooden bottle cases estimates his production at 40,000 cases per month. The particular production problem relates to the grooving and hand-holing of the two end pieces and to the grooving of the two side pieces. The cycle of operations is shown diagrammatically in Figure 1. The end pieces, requiring two separate and distinct operations, are handled twice as often as the side pieces, which require but one operation.

In This Case, "Yes"

In order to eliminate excessive handling of work in process, a machine incorporating two stations of work —namely, grooving and hand-holing—was designed. Although improved design permitted an increase in the speed of the hand-holing operation, the greater time-saving features are those caused by reduced handling. The new cycle of operations is considerably simplified as shown in Figure 2.

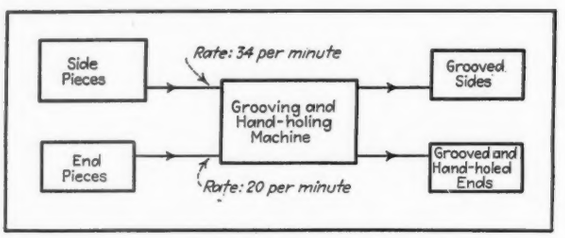


Figure 2

The next logical step is a determination of the actual manufacturing costs involved in the two methods of production. To simplify calculations it is assumed that the operating cost for both methods is the same. Actually the new method is cheaper because there is less handling.

Based on an 8-hour working day and a 23-day working month, the new equipment can produce in one month a sufficient number of finished sides and ends for approximately 70,200 bottle cases. As the actual production requirements call for but 40,000 cases per month, the equipment will operate but 57 per cent of the time.

Table I

	Old	*New*
Time for 2 sides	0.059 min.	0.059 min.
Time for 2 ends	0.192	0.100
Time for 1 case	0.251	0.159
Operating cost: power, overhead, labor—per min.	2.87¢	2.87¢
Cost per case	0.722¢	0.456¢

Saving produced: 0.266¢ per case

To justify the installation of special manufacturing equipment, it is commonly asserted that it must pay for itself out of its actual savings within a period of two years. The product manufacturer is entitled to a definite return on his capital investment, after the equipment has paid for itself. This rate of net profit return is often taken at 20 per cent after the yearly depreciation charges have been deducted.

Total possible savings per month:
70,200 cases × 0.266c. = $187
Actual saving at 57 per cent activity:
$187 × 0.57 = $106
Cost of new equipment, including installation $2,200
Scrap value of old 200
Net cash investment $2,000
Time required for self-payment of new equipment:

$$\frac{106}{2{,}000} = 18.8 \text{ months}$$

Yearly profit return on capital investment:
Actual savings per year $1,272
Deduct 10 per cent yearly depreciation on net cash investment 200
Yearly return $1,072
Rate of net profit return:

$$\frac{\$1{,}072}{\$2{,}000} = 53.7 \text{ per cent}$$

As a final step in determining the justification of replacing the old equipment with special manufacturing equipment, we calculate the percentage of manufacturing activity necessary to fulfill the requirements of a 10 per cent yearly straight-line depreciation charge and a 20 per cent yearly net profit on the capital investment.

20 per cent yearly earning on net cash investment $400
10 per cent yearly depreciation 200
Total necessary yearly earnings $600
Total necessary monthly earnings ..... $ 50

The percentage of activity which will justify replacement will be the ratio of total necessary monthly earnings to total possible savings per month, or, 26.8 per cent.

The first assumption that total operating costs are constant would tend to favor the old equipment. Bearing this in mind, the only logical conclusion that can be drawn from Table II is that the installation of the new specialized manufacturing equipment is justified.

Table II

Prerequisites	*Actual Results*
Pay for itself within 2 years	Paid in 18.8 months
Rate of net profit over 20%	Rate is 53.6%
Necessary activity is 26.8%	Activity is 57%

But in This Case, "No"

When the rise of production requires the addition of supplementary manufacturing equipment, a careful cost and production analysis will help to avoid pitfalls. Our bottle case manufacturer has found that he can dispose of 100,000 cases per month, which is greater than double his former production. A hasty conclusion might lead to the installation of another complete grooving and hand-holing unit, duplicating the cycle of operations shown in Figure 2. An examination will show that the cost per case is still 0.456c. A production analysis would lead him to a different cycle of operations with the addition of but one grooving machine as shown in Figure 3.

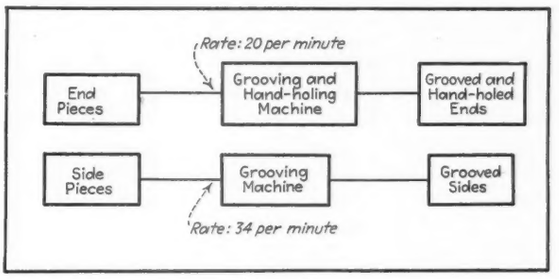


Figure 3

Handling of the work in process is simplified as end pieces are worked independently of the sides. Table III gives a condensed cost analysis of this production method. A comparison of the two production methods will show the value of a cost analysis.

Table III

Time for 2 sides	0.059 min.
Time for 2 ends	0.100
Operating cost of grooving and hand hole unit	2.87¢ per min.
Operating cost of grooving unit	2.20¢
Cost of 2 sides	0.129¢
Cost of 2 ends	0.287¢
Cost per case	0.416¢

Two grooving and hand-holing units:
Cost of equipment installed $4,400
Possible monthly production ..... 140,400 cases
Necessary monthly production ..... 100,000 cases
Percentage of activity 71.2
Cost per case ..... 0.456c.

One grooving and hand-holing unit and one grooving machine:
Cost of equipment installed $3,400
Possible monthly production ..... 110,500 cases
Necessary monthly production ..... 100,000 cases
Percentage of activity (basic) 90.4
Cost per case ..... 0.416c.

With a monthly production of 100,000 cases and a saving of 0.04c. per case, the monthly saving becomes $40. The net cash investment is reduced by $1,000. The over-all percentage of activity is considerably increased. Hence the installation of two complete manufacturing units is, in this case, *not* justified.

P. S. A third more shipments

This postscript to an article published last October proves that the last word in cost reduction work is never said

W. J. Otto
Comptroller
The Wahl Company, Chicago

THE PACKING line described in "Red Ink or Black?" (October, 1933, p. 389) looked to us when it was set up like the last word in economical layout. But if our experience is any proof, the last word in cost reduction is never said. Without additional help our shipping line is now handling, checking, and packing 37½ per cent more packages a day.

Changes required were of the simplest and most inexpensive. Figure 2 is taken from the same point of view as Figure 1, which appeared in the original article. The cabinet in the background of Figure 1 has been moved to permit an extension of the bench, which may be seen in the background of Figure 2. At this bench the checker receives the pens as delivered by the storeroom. The extension not only gave her more room to pile enough work ahead to avoid interruption, but permitted her to carry a stock of the advertising display material which is often ordered with the merchandise and to assemble this material with the order. This work had formerly been done by the wrapper, who, by the nature of his work, was less likely to make a systematic check and to see that the proper inserts went with every order.

From the checker the trays of pens, pencils, and other material were passed to girls who packed the pens in the individual boxes in which they are sold by the dealer. An overhead rack was built, as shown in Figure 2, to hold a reserve supply of those boxes.

An awkward break in the process had been caused by the need of carrying the boxed pens and pencils across the aisle for final packing and wrapping. This was remedied by building at the delivery end of the boxing tables, the table shown in the foreground of Figure 2. On this table the packages to go by parcel post travel directly from boxing to wrapping and weighing and into mail sacks at the left end of the table, just beyond the scales. Freight and express shipments are routed by the checker down the boxing table at the right in Figure 2, which delivers directly to a packing bench for this type of shipment.

Hinged shelves connect the boxing tables at the receiving end with the checker's table and at the delivery

Figure 1. Last October they thought this was the last word in economical layout

at less cost

Figure 2. The new packing set-up. Still more waste motion has been taken out

end with the mail packer's bench. These shelves make it possible to shove the work along without interruption. At the same time, if a rush should develop at one of the tables, due to preponderance at one table of a particular class of shipments, the hinged shelf can be lifted and in a moment an operator or two at a less busy table are relieving the point of pressure. The girls are quick to cooperate, for the entire group is paid a group bonus based on total output.

The bench at the left is used chiefly for long jobs of boxing on big orders, which may or may not go directly to packing. This table is also available for reserve capacity in any rush period, the long jobs ordinarily being of such a nature that they can be laid aside for a few hours if necessary.

The new set-up, while providing full flexibility when needed, clearly makes possible a more direct and orderly flow of work. There is a noticeable reduction in the confusion and running back and forth, the need for which was obviated by bridging the gaps existing in the older plan of flow. The principal savings have resulted from this elimination of waste motion, obvious enough once we studied the old layout from the point of view of motion economy.

▼ ▼ ▼

Concluding a series of twelve articles on

Production Control

12. Costs

Thomas M. Landy

TO BRING these articles on production planning and control to their natural conclusion, we must now consider the mechanics of cost recording and reporting. The methods now to be described are those which can be applied with a minimum of paper preparation and work. The problem is to get the cost facts and send them on to the cost and payroll sections.

When paper is prepared by the hectograph method a "shop record and cost card" (see May, 1933, page 196) is made. All time is posted on this record, and when the order is complete the card is sent to the cost department, where it serves as a detailed labor cost of the part.

Likewise in departments using the mechanical method of paper preparation a similar card (Figure 1) is made from the original dupligraph plate and sent to each dispatch station having one or more operations to perform. It is first filed in the dead load file by raw material date, and thereunder by drawing number. When the material arrives in the section the card is removed to the live file. Here it serves as a shop record and sub-index.

All time is posted on this record, space being provided on the reverse side for the recording of twenty jobs, and

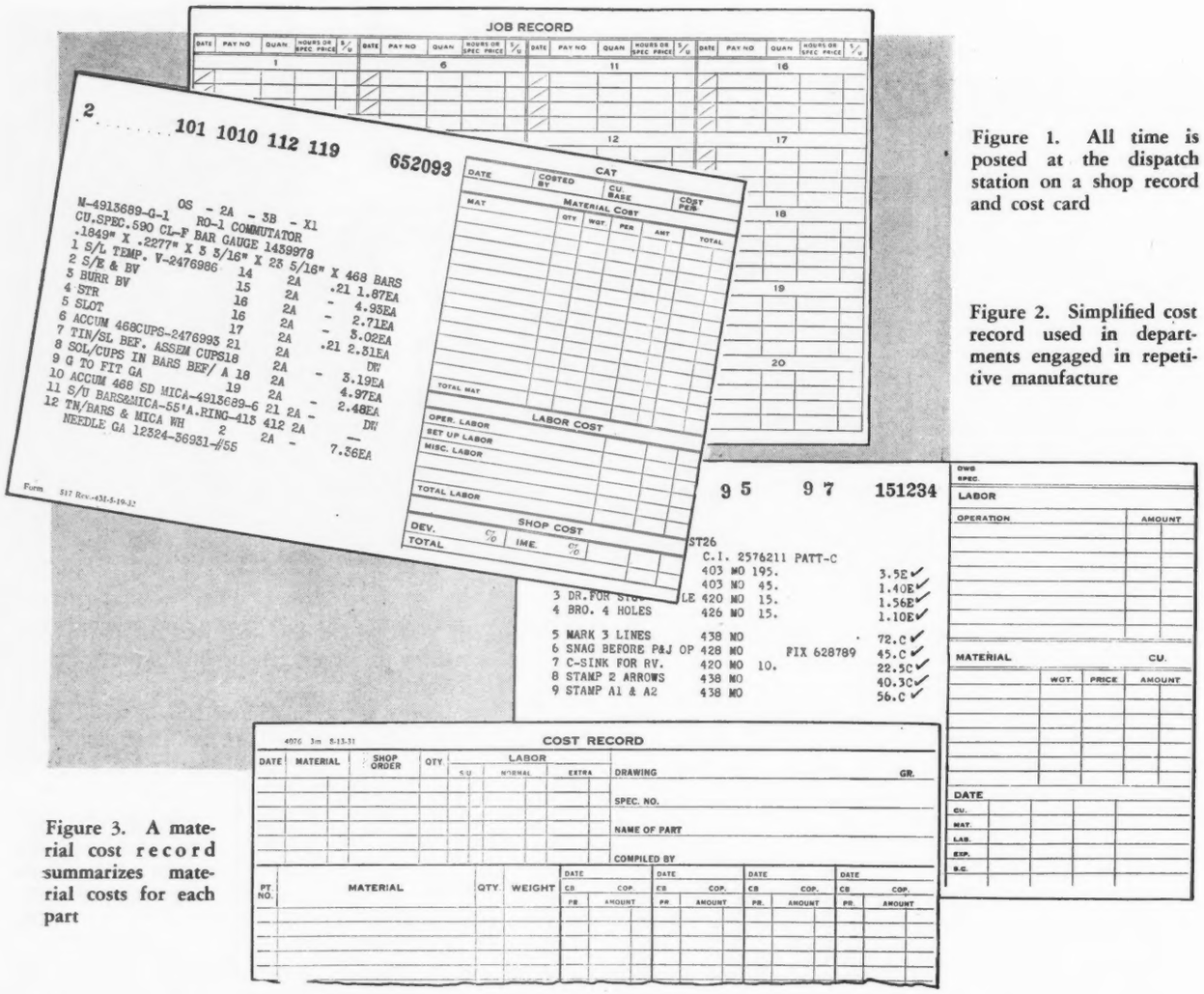


Figure 3. A material cost record summarizes material costs for each part

each time the dispatch order is moved on the board a new index entry is made. All vouchers clear through the dispatch station in the section where the work is performed, and under no conditions is the voucher released unless there is a corresponding entry on the record.

Every item on the card shows quantity completed, piecework or special price per unit, daywork hours, and rate per hour. Labor performed on inspectors' reports (see April) carries the I.R. number following the operation. Extra labor operations are designated by symbols, as *A* for equipment trouble, *B* for delays waiting for cranes, etc., *C* for defective work, and so on.

When all the time has been turned in, the card is sent to the cost department where, with similar cards from other departments, it serves as a complete costing of the job. By this method the costing is done as each job is performed. Not only does it mean a clerical saving in the cost department, but it is a distinct advantage to have the costing completed as soon as the job itself is finished. It is unnecessary to send a copy of the time voucher to the cost department.

Perhaps the greatest advantage of this method lies in the fact that it frees cost clerks from a mass of clerical work and leaves them more time for cost analysis.

It should be stated here that in plants or departments engaged in repetitive manufacture the cost card can be simplified. For this class of work a card like that shown in Figure 2 is recommended. Here the card is simply checked as each operation is performed, any extra cost being of course posted.

Material Cost Summary

There now remains the material cost record (Figure 3), which is really a summary sheet. One is made for each drawing, and on it is listed the material that goes into the various parts. Then the labor card is transferred from the shop record and cost card. An alternative method is to post the labor cost on the title block (as described in *Factory and Industrial Management*, Feb., 1933, p. 67). Either the cost record or the title block is filed as a permanent record of the cost of labor and material. From these a recapitulation sheet is made, and so we have the complete cost of the job almost as soon as the parts are finished. Costing is not only speeded up, but is done with less clerical help—and more accurately since all paperwork is original except the cost record card just described. Even this is made unnecessary by revising the title block on the drawing (again see February article); each time a print is made a copy of the title block is run off for the cost department.

Probably the greatest good derived from production

planning and control by the payroll department is the speed and accuracy which accompany the delivery of time vouchers.

Payroll Procedure

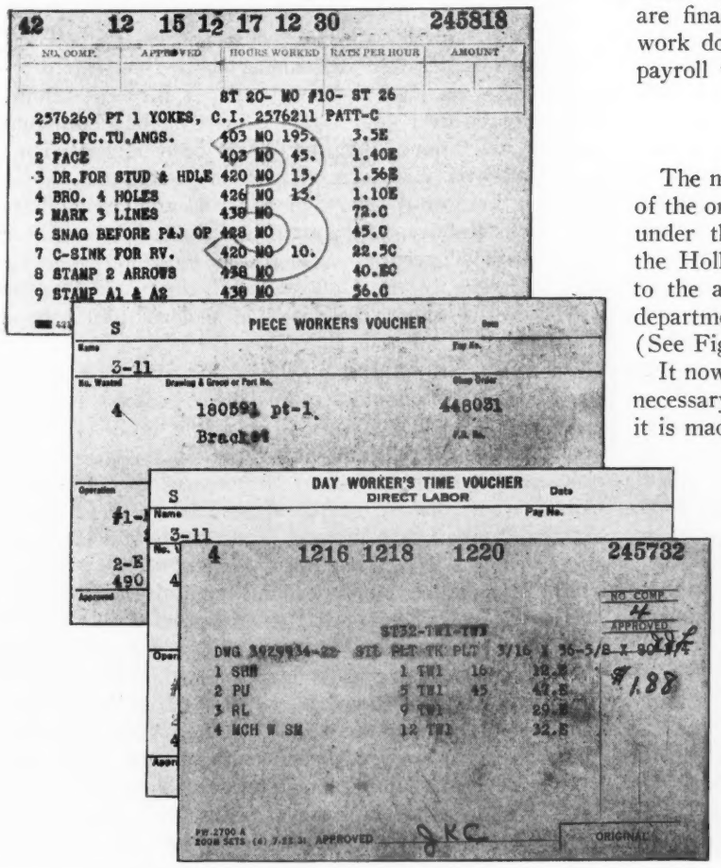
There is, incidentally, a tendency in some very large plants with decentralized manufacturing set up to break down the payroll department and to turn over to each decentralized unit its own payroll procedure. The unit payrolls are then sent to a central payroll department, where such deductions as "sick and benefit," "insurance," etc., are made. The net payroll is then made up.

I feel strongly that only under unusual conditions should the payroll department be decentralized. It should remain a central department serving the entire plant. The advantages of such a set-up are greater economy, closer supervision as to policy, less clerical help, full-time operation of mechanical payroll machines. Also there is a distinct benefit from having all employees' records and data available in one place.

One plant with nine decentralized departments and about 4,000 employees has retained its centralized payroll department and operates it with eighteen people—who also issue all labor reports and other statistics for the manager. Another plant, with only a few more employees, has decentralized its payroll department and now requires 65 people to do the work.

Payroll procedure is simple. As soon as time vouchers are turned in at the various dispatch stations and the times have been posted on the shop record and cost cards, the vouchers go to the payroll department. This practice eliminates payroll peaks.

Figure 4. Various types of payroll vouchers. A steady flow of vouchers eliminates payroll peaks


42 12 15 12 17 12 30 245818
NO. COMP. APPROVED HOURS WORKED RATE PER HOUR AMOUNT
ST 20- MO #10- ST 26
2576269 PT 1 YOKES, C.I. 2576211 PATT-C
1 BO.PC.TU.ANGS. 403 MO 195. 3.5E
2 FACE 403 MO 45. 1.40E
3 DR.FOR STUD & HDLE 420 MO 15. 1.56E
4 BRO. 4 HOLES 426 MO 15. 1.10E
5 MARK 3 LINES 438 MO 72.C
6 SNAG BEFORE P&J OP 428 MO 45.C
7 C-SINK FOR RV. 420 MO 10. 22.5C
8 STAMP 2 ARROWS 438 MO 40.EC
9 STAMP A1 & A2 438 MO 56.C
S PIECE WORKERS VOUCHER
3-11
4 180591 pt-1 448081
Bracket
DAY WORKER'S TIME VOUCHER
DIRECT LABOR
S
3-11
4 1216 1218 1220 245732
ST32-TW1-TW1
DWG 3929934-22 SIL PLT TK PLT 3/16 X 56-5/8 X 80-3/4
1 SHR 1 TW1 16 12.E
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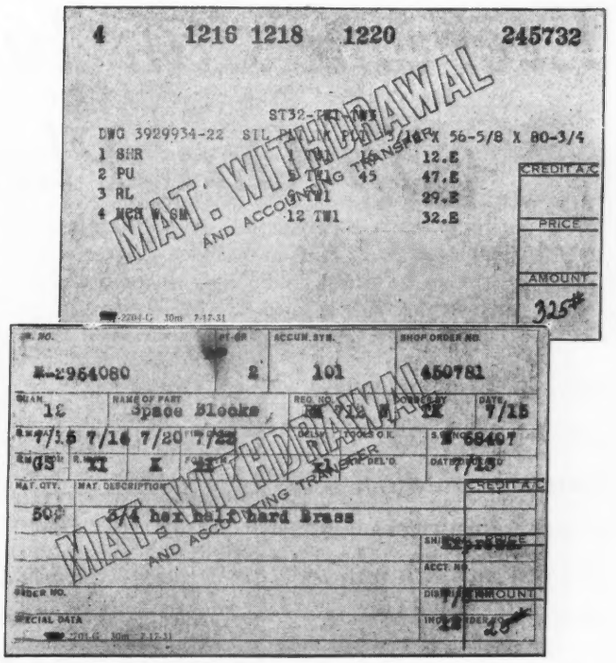


Figure 5. Material-withdrawal cards are part of original paper whether hectographed or prepared mechanically

Vouchers are then filed by operators' clock numbers and extended. Gross payroll is then compiled—and after deductions have been made, net payroll. Vouchers are finally filed and constitute a permanent record of work done by the various operators. Various types of payroll vouchers appear in Figure 4.

Material Control

The material withdrawal and accounting transfer copy of the order—prepared as part of the original paper both under the hectographing and mechanical methods—or the Hollerith card, which may be used instead, is sent to the accounting department by the order and stores department after being written off the stock ledgers. (See Figure 5.)

It now goes to the material ledger man who makes the necessary entry. If a transfer of material is necessary, it is made. The copy is then sent to the respective cost divisions, where it is posted on the shop record (or upon the title block) previously supplied by the dispatch stations. If the title block is carried out fully as to net and gross weights, the raw material copy can be extended when set up, thus eliminating this work in the accounting and cost departments. Obviously this procedure should decrease waste material, since each foreman is furnished exactly what is necessary.

[Previous articles in this series appeared in the January and February, 1933, issues of *Factory and Industrial Management*, and in the March, April, May, June, July, September, November, 1933, and January and April, 1934, issues of *Factory Management and Maintenance*—Ed.]

Everyone's an Inspector in Our Plant

Surveys of everyday conditions are no longer perfunctory because employees are picked at random to make them

C. S. Stevenson
General Manager
Hall Brothers, Inc.
Kansas City, Mo.

"INSPECTION with a Personality" is the name we have given to a plan that combines personnel welfare with building maintenance. While every factory has regular inspections of machinery, equipment and plant, which are—and should be—made by experts, this inspection is made by employees picked from the factory at random, without any notice—people who may be for the second or third time of their employment out of their own departments. It is a survey of everyday conditions.

This is how it all came about. We manufacture greeting cards. We believe that they can be properly produced only under congenial, orderly, well-regulated circumstances. To maintain a consistently high level of working conditions, the factory manager had for several years been making semi-monthly rounds of the plant, taking along a stenographer to whom he dictated memos and suggestions. The trouble was, the trips got to be routine. Many things were taken for granted. Finally he began to pass up these inspections for two or three months at a time, feeling they were not particularly helpful. Slowly but surely the factory began to look shabby.

President Proposes

One day the president took a visitor through the plant and at once noticed the change. He suggested that the manager take along a couple of department heads, then perhaps let three department heads go out alone.

Thirty minutes later the manager, two veteran foremen, and a stenographer went on an inspection tour. When it was over four hours later, they had been into plans where three of them had never been before. They had made over 200 notes, almost one a minute.

After three or four similar trips, a simplified follow-up system was devised, so great was the task of checking up on each suggestion. The results were long remembered. Stocks were straightened, bins dusted, incidentals discarded—in short, the place in general got a good cleaning.

An additional feature of the plan was that each department was rated and standings were posted. For this purpose, the plant was divided into four sections—press room, bindery, offices and stockrooms.

The variety and extent of the criticisms and suggestions were a constant source of surprise to the management. As a rule, department heads rarely had ideas for improvements in their own sections, but they could generally be counted on for some suggestion in another section. One instance was that of lights. The printing department had worked for years under open bulbs hung low on cords strung at random. One of the best of the early suggestions was a criticism of this antiquated method—and it was made by a committee on which the pressroom was not even represented. New equipment costing several hundreds of dollars was installed.

"Do you know I have never been in this department in the five years I have worked here," casually remarked

a member of one committee to her companions. This immediately gave the others an idea, and one suggestion turned in was: "Why don't you arrange for all employees to be taken through the factory?" The idea was adopted, and when the tours were announced on the bulletin boards, more than a hundred employees asked to take the trip. Also plans were made so that new workers are given this same privilege, after 60 days' employment.

Odd-colored and odd-shaped pillows were noticed on many of the chairs in the bindery. Questioning disclosed that the wooden seats became hard. Each worker is now supplied with a sponge-rubber seat pad—an innovation, incidentally, that proved to be unusually popular. At the same time cushioned gliders were put on the legs of the chairs, making them much easier to move. More important than that, they eliminated the screech of the chairs on the concrete floors when workers arose or moved about.

What the Girls Did

Three girls comprised the committee one month. The top memorandum, when the notes were given the manager was: "We suggest that space be allotted and fixed up that can be used as a rest room for girls who are sick. We do not want a recreation center—merely a place to rest when needed."

This plea hurried a study, then under way, of such facilities in other industrial plants, and eventually resulted in a health service, consisting of a two-bed hospital room with necessary equipment and presided over by a registered nurse.

The soap being used in the men's and women's washrooms for a number of years was of coarse texture, being bought primarily for mechanics. Because it had been used so long, no one thought it could be changed. After one committee report, conversation with a few of the girl employees disclosed the fact that everybody thought the girls should have a softer soap, but nobody had said anything about it. It developed in the change that the flake soap installed could be supplied cheaper than the mechanics' soap, so in this instance employees were gratified and the company made a sizable saving.

As the result of a suggestion from a woman leader, exhaust fans were put in each washroom, with grills cut through the doors to allow better circulation of air. At the same time a rearrangement of locker space results in more room in the nearby cloakroom.

Reports Are Informal

The nature of these inspections and their possibilities are quite obvious by a glance at the accompanying list of criticisms and suggestions that have been made. They are addressed to the department head under fire, going first, of course, to the factory manager for his recommendation, and then to the various offenders.

On the face of it, this form of inspection might appear to be trivial. Or it might be said that proper management would eliminate most of the recommendations. This method does more, however, than get bins dusted, windows fixed, tables painted, door plungers attached, and such. It gives to all employees a personal interest in the cleanliness, orderliness, and condition of the plant. It puts color into what is generally a perfunctory mission—and one begrudgingly undertaken. A good-natured rivalry has developed between department heads, and there has never yet come from the results of these tours anything that might even remotely be construed as ill-feeling.

The spirit between the employees and the management is obviously quite friendly. Suggestions are made by the committee with the knowledge that they may not be adopted, but will be given full and courteous consideration. The plan has now been in existence for several years, and each committee starts out fully as enthusiastic as did the original one.

While this "Inspection with a Personality" could not possibly replace maintenance surveys and would obviously do little good on the important matters of building and equipment repair, there is a definite place for it in factory management. Personnel welfare is important as a factor in successful operation. Employees are certain to be happier in congenial surroundings than in those not so acceptable, and while the results of this novel idea will not show on charts and graphs, the advantages and benefits are of a nature that gives considerable satisfaction both to employee and employer.

This is how they report what they find

BARR—Those accessories on north table should be moved. They have been reported twice.

MOEWS—The girls on fourth floor are asking again about fans. Mr. Stewart wants you to check the temperature there daily for one week. See him regarding this.

MISS BUCHANAN — North bins need dusting.

VERNIE—Envelope linings do not have yellow dust sheets on them.

HERMAN — Condition of storeroom shelves is bad. Old rubber gloves, pieces of pipe, etc., should be discarded.

JOE — Why didn't you sweep out the boys' locker room after lunch today?

JULIAN—Window in west annex is cracked and should be replaced.

MOEWS — Miss Prentiss wants rubber rollers on her chair.

MISS McKAY—The display room needs straightening out. It is somewhat dusty, also.

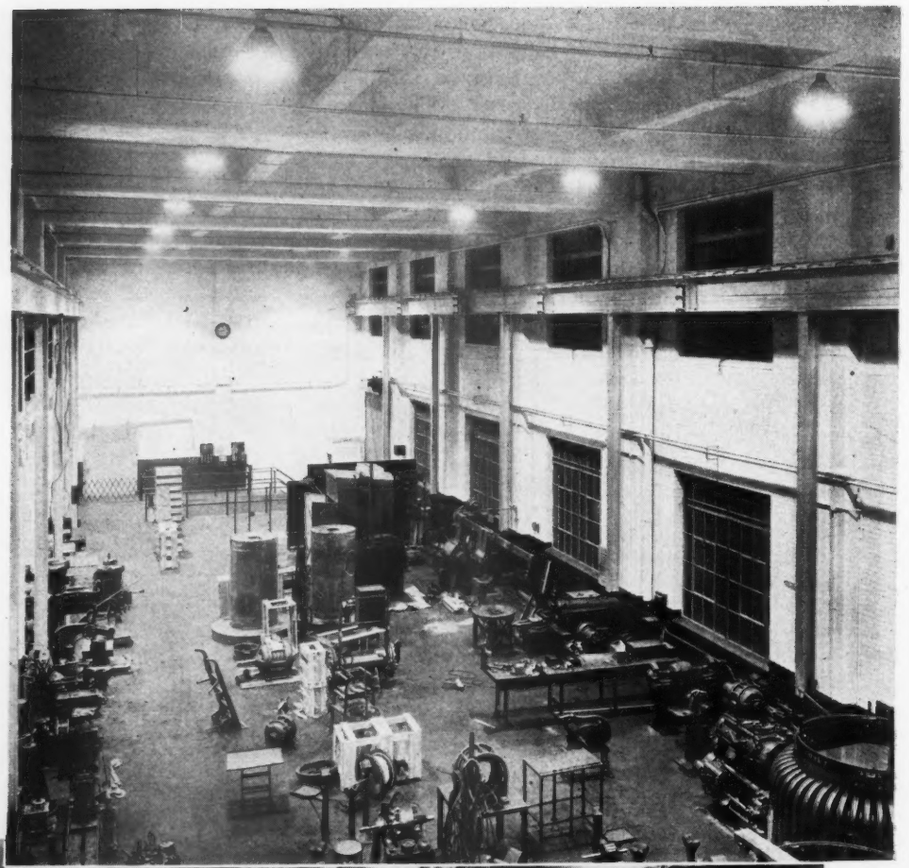
JULIAN — You have overlooked putting those new gliders on six chairs in the watercolor department and the girls are asking for them. See Miss McQueen, please.

SISK — The tag and seal department needs a good cleaning up—and plenty quick, too.

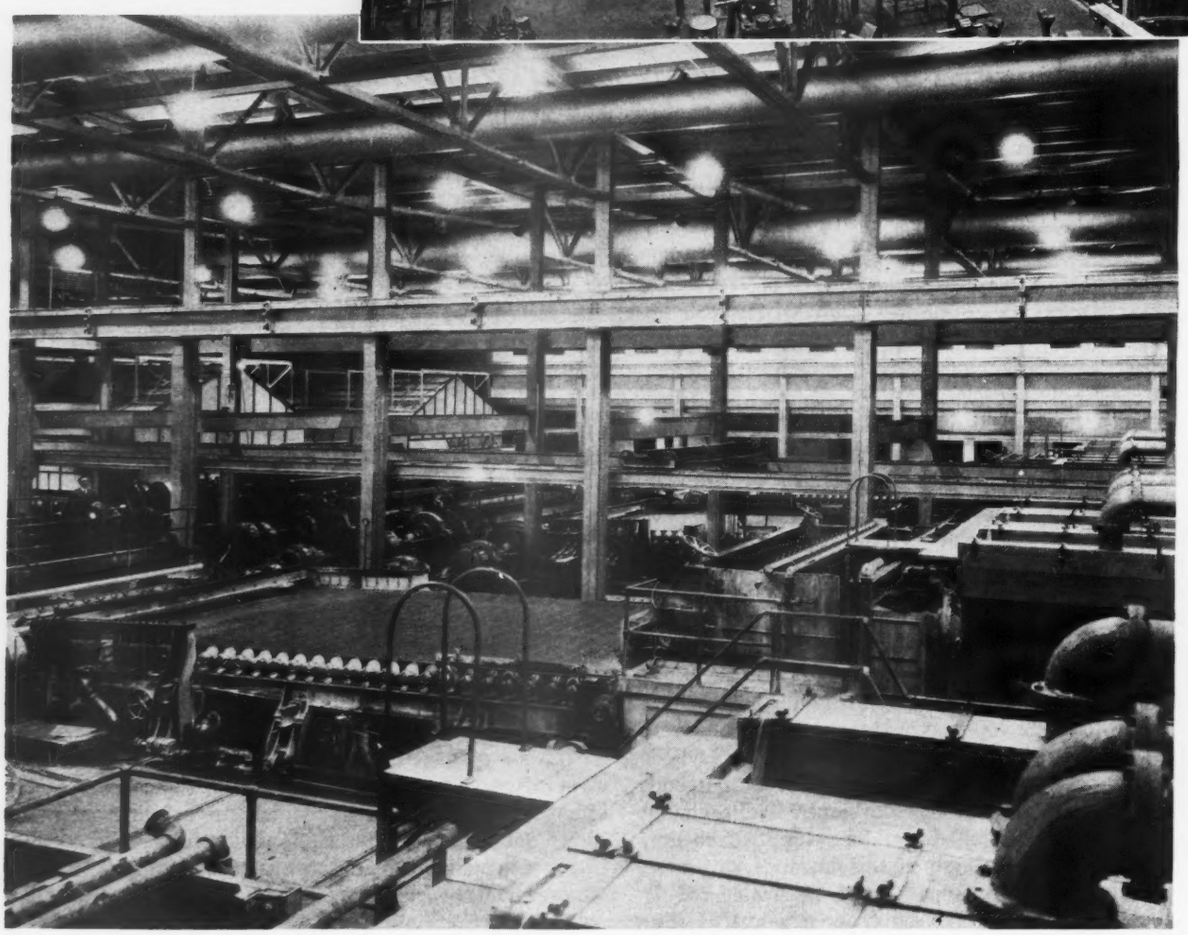
WAMPLER—There is a lot of oil on the floor under your embossing presses.

MISS McQUEEN—Your girls are getting careless about storing table covers when not in use. Where are the boxes provided for them?

High Lights



High ceilings require reflecting equipment designed to throw most of the light downward. Diffusion to eliminate excessive contrasts and deep shadows is greatly aided by proper painting of wall surfaces and equipment. In the paper mill below, 500-watt lamps 31 feet above the floor, and on 18x26-ft. spacing, effectively illuminate the working area



FOR BETTER SEEING

Is Now the Time to Restore Incentive Plans?

A strong believer in financial incentives shows why, in his opinion, it will be well to make haste slowly

Adolph Langsner
Chief Engineer and Superintendent
Eugene Dietzgen Company, Chicago

MANY factories which abandoned their incentive plans during the depression face the question, as output begins to increase again, of restoring them. There is in my mind no question of the ultimate advisability of paying on an incentive basis, which in my experience normally yields a 30 to 40 per cent increase in production with no feeling of crowding or excessive fatigue on the part of the man. But, is now the time to restore the premium, piece-rate, or other plans laid aside in the last three years?

Consider for a moment only the validity of the old rates it is the intention of many companies to restore.

Those rates were, many of them, set during the abnormal business and labor conditions of 1928 and 1929, or under the even more impossible conditions of disturbed production, doubts and fears, unbalanced functional organization, disorganized lines, and abnormal inventories which have prevailed since those years. Even if we were to return to the days of 1929, existing rates should mostly be suspect until they have been carefully retimed and tested.

Other Times, Other Conditions

But we are not going back to 1929. For one thing, labor conditions are not those of that year. Some of the factories making staple consumers' goods such as foodstuffs may have been able to retain something like a normal working force during the depression. That is far from true in the capital goods industries. Many of the latter have had hardly more than skeleton organizations, and even these few workers have been working under abnormal conditions. The man called back to work after being idle for two years has almost to learn his trade again.

I watched one. His output before he was laid off had been 40 to 45 pieces a day. Eager to prove to himself that he was as good a worker as ever, his hands trembled in his effort to regain his habitual pace—the best he could do was 30 pieces. It will be some time before he is back to his old speed.

However, only a fraction of workers will come back to their previous jobs. During the next few years industry faces the problem of training large numbers of people from the ground up. We must expect the tensions that arise when skilled and unskilled people work at the same job, but under different wage contracts or with different earnings. The wisdom of unnecessarily increasing these tensions by re-introducing an incentive plan right at the beginning of a wholesale breaking-in period is questionable.

Is High-Production Basis Permanent?

Still another question is whether the present revival of business will proceed without interruption. We hope it will, but so far have seen little activity in the capital goods industries beyond that inspired by government purchases which, helpful though they have been, can hardly go on forever. Payrolls for January, 1934, according to the U. S. Bureau of Labor Statistics, were only 49.8 per cent of those for 1926. Until we are more certain that we can continue to give work to employees, we must hesitate to ask them to resume a high-production basis which we may not be able to continue.

So far the argument has proceeded on the assumption that we have merely to return to the conditions normal in the past. But who expects to? I, for one, do not.

Consider first the changes which are affecting general working conditions. In an article published several years ago in these pages, advocating performance standards obtained through time and motion study, I predicted that a 40-hour week would eventually replace the 48- to 52-hour week then prevalent. But I never dreamed then of the far-reaching governmental experiments and molding of public opinion which have set up such objectives as the 30- or 36-hr. week. With the return of the unemployed to work we shall probably have less urgency for a week as short as that now advocated, but we are unlikely to go back to a working week much longer than 40 hours.

Also in spite of a general and highly commendable effort to hold up wages on the part of employers, most of whom have proved socially minded to a high degree, it cannot be denied that labor has experienced one of the greatest setbacks it has ever had. But we have learned that the interests of wage-earner and employer, however much they may appear on the surface to

diverge, must in a fundamental sense coincide. High real wages are desirable not merely to encourage production, but because without them national buying power dries up and the manufacturer's product rots unused on his shelves.

If we are to maintain high real wages and at the same time shorten working hours, we must increase, not decrease, production. The policy of restriction of production may serve during an emergency to distribute what food and goods there are to more people, but in the end it can only mean a lower standard of living and greater misery for all. And the problem of meeting this challenge to greater production is put squarely up to the manufacturer. Labor will not solve it for him; government cannot. He must himself, as never before, take stock of his methods and his machinery and his policies, reject and replace those that are obsolete, and improve still further those that are good.

Search Costs with Eyes Open

During the depression years, for instance, one manufacturer took stock of his machines. He found that he could lay aside over 800 of the oldest of his 2,480 machines, and with the 1,600 that remained, do all that would ever be required of them, with a saving of one-third in floor space, maintenance, and overhead factors. The expenditure for rearrangement and incidental new equipment was considerable, but the gain in net income more than justified it.

Many a firm, if it searches its costs with open eyes, will conclude, as one company did, that a substantial part of its investment in tools and dies, special fixtures, and special machinery is just so much junk, to be replaced or retired as quickly as possible. That firm is going over its entire line, redesigning and improving with the double objective of lower costs as well as better service and a new selling appeal. For part of the recovery of the capital goods industry must rest on its ability so to improve the things it manufactures that the customer cannot afford not to replace his present equipment.

Here, then, is something else to give pause to any precipitate crystallization of the wage incentive situation. Setting time standards is in the nature somewhat of a capital expenditure; such standards, while gradually growing obsolete individually, ought as a whole to serve for several years. Any expenditure in setting them, immediately in advance of changes as drastic as those now in prospect, is likely to be largely wasted, because standards set now can at best be only temporary.

Natural Bitterness

There is also prevalent a surprising degree of bitterness toward incentive plans, not only among shop employees, but among engineers, professional men, and other white-collar workers. During the depression, when hundreds of their fellows were losing their jobs and hardly anyone seemed secure, it seemed a heartless thing on the part of the employer and a betrayal on the part of the worker, for the sake of a few pennies of extra earnings and output, to speed the pace and throw still more people out of work. It might have been argued that by cutting costs the employer could have gotten more business and put more people to work. But conditions during the last two years have so concerned employer and employee alike that no imaginable decrease of cost would have greatly increased business.

There is, I believe, in some localities, a better grounded objection than this temporary one to incentive plans, and it should serve as a warning against haste or carelessness in the setting of rates, unless it is made very clear to the workers that these rates are temporary and subject to early change.

In some industries there is little question that wage incentive plans have been used, consciously or unconsciously, as schemes for rate-cutting. I have had men come into my office and tell me that, if labor costs exceeded certain ratios, they could guarantee substantial payroll savings. When asked how they expected to make them—whether by time study, by improved layout, by better processes or other cost reductions—they assured me that all that was needed would be to install their wage systems.

Now there are undoubtedly many factories in which the working pace, under poorly set standards or none at all, is so slow that the employer is justified in demanding more work for his money. But to attempt to remedy a lack of standards by another system which does nothing to supply the lack is, to my mind, unsound and dangerous practice. The wage plan itself may be good enough when based on good standards, but no wage plan is better than the time-and-motion or other output and method studies on which it rests.

Evidence of Superficial Methods

It is well to recall Stanley Mathewson's investigation of restrictions of output.* He interviewed 350 workers in 105 establishments in 39 industries, found 223 who deliberately restricted output. Out of the 223, two-thirds had been "time-and-motion studied." I am not carried away by Mr. Mathewson's disclosures. I realize that increased progress has been made and that worthwhile results have been secured by properly made time and job studies. But these studies do furnish one bit of evidence of the superficial methods used in many plants, and of the failure to win the confidence of workers.

Some manufacturers, more foresighted than the majority, have seen the handwriting on the wall and have used the depression period to put their houses in order. But for the rank and file of employers, eager to get back to the benefits of their incentive plans, a word of caution may not be amiss. It is not a time to try quick or new medicines. A revival after a depression is traditionally a time of labor tension. Those employers who have the patience to build the necessary new foundations before announcing unrestrictedly guaranteed or permanent labor standards may find that tension has abated by the time they are ready to announce permanent rates. In any case, by going after wastes instead of attempting to take the necessary cost reductions out at the expense of the workers, they are likely to make savings quite as large as would be possible under the latter plan, and while doing so retain the respect and confidence of their employees.

**Restriction of Output Among Unorganized Workers*, The Viking Press, 1931.

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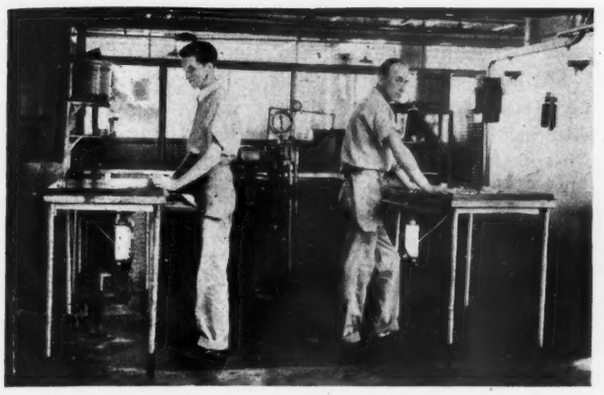


Electric heating units beneath the tops of these tables in the elastic capsule department of the Sharp & Dohme, Inc., plant, Philadelphia, keep gelatin molds always at the exact temperature required

•

Receiving Line Has Built-in Fumigation

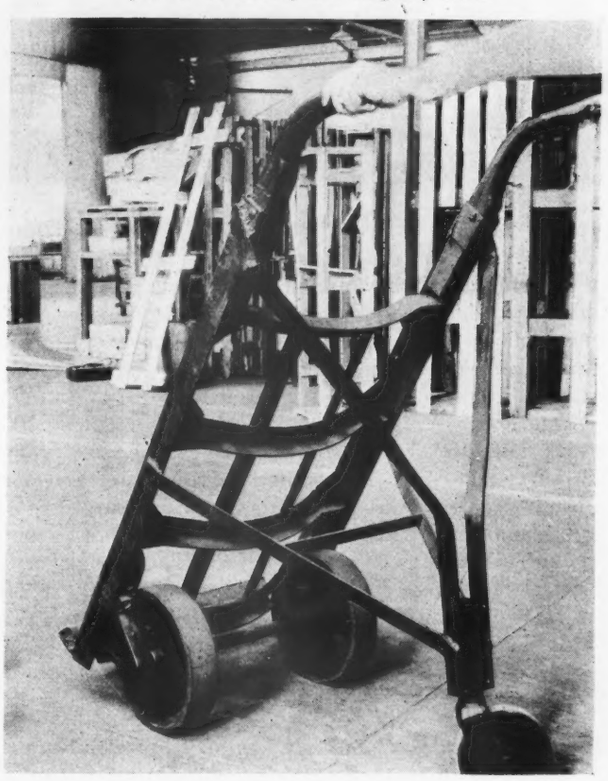
In the continuous war against insects, food manufacturers have to guard all susceptible material both during storage and while in transit to and from processing. Fumigation, with the development of new and safer gases, is adaptable to all forms of materials, both incoming and outgoing, and is the principal pest control feature in every good plant and raw material storehouse.

Extending through the wall between the receiving department and the plant itself one company has installed large tubular fumigating chambers. Incoming material

which needs protection against insects passes through these tubes and is fumigated on the way to the processing departments. Likewise, finished products pass through similar chambers to be "gassed" before shipment lest they become infested during transit.

Self-Supporting Truck Saves Muscle

JOSEPH C. COYLE, Los Angeles, Calif.



The caster at the rear makes it easy to move heavy loads with this truck. It is particularly adapted to handling large sheets of metal.

Braces welded to the angle-iron sides are ½x2-in. steel, with two short sections welded in near the bottom end. These pieces are drilled to form a socket for the shank of the caster, which is held in by a pin and cotter key.

•

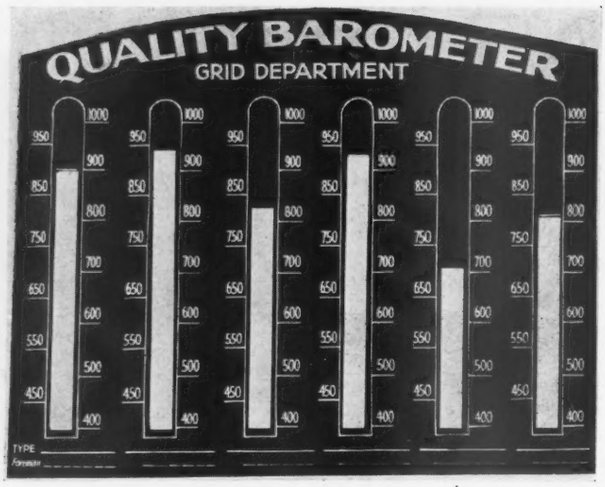
Quality Barometers

SOURCE, Hygrade Sylvania Corporation, Salem, Mass.

In the stem, heater, coil and grid departments, we have barometers. They are adjusted three times each day, to show the quality of the work done by each department—at nine in the morning, at twelve noon, and at three in the afternoon. The readings present an exact indication of the kind of work being done.

The parts quality department has charge of all barometers, and it is from the results of the inspections made by them that quality ratings are determined.

Inspections are made on a 5 per cent basis—that is, five parts out of every tray of one hundred are inspected



for all possible defects. The defects are divided into three groups, based on the seriousness of the effect on the operation of the finished tube. Group A includes all serious defects such as might make the finished tube inoperative; group B includes such defects as might cause the finished tube to be finally rejected; and group C includes minor defects.

One group A defect found by the inspection of 100 parts takes 100 points from a perfect score; one group B defect takes 50 points from a perfect score; and one group C defect takes 25 points from a perfect score. For example, an inspection of 100 parts showed one group A defect, two group B defects, and one group C defect. The score for our barometer will be 100 + 50 + 50 + 25, or 225 points from a perfect score of 1,000. This is equal to 775 on the quality barometer.

•

Electric furnaces save Thompson Wire Company, Mattapan, Mass., $1.87 per ton in high-carbon steel treating, $2.66 in low-carbon. Annealing cycle 35 per cent faster. Quality better.

•

Taking Lots in Order

A. L. VANCE, Chicago

In most plants it is advantageous to keep shipping goods in the order in which they were manufactured thus avoiding the accumulation of old stock. This is particularly important, of course, where the product is perishable.

A simple plan accomplishes this at Abbott Laboratories, North Chicago, Ill. Many of its products are sold in small lots, perhaps a single bottle or a few bottles to an order. This open stock is kept on steel shelving in the active stockroom where orders are picked and filled.

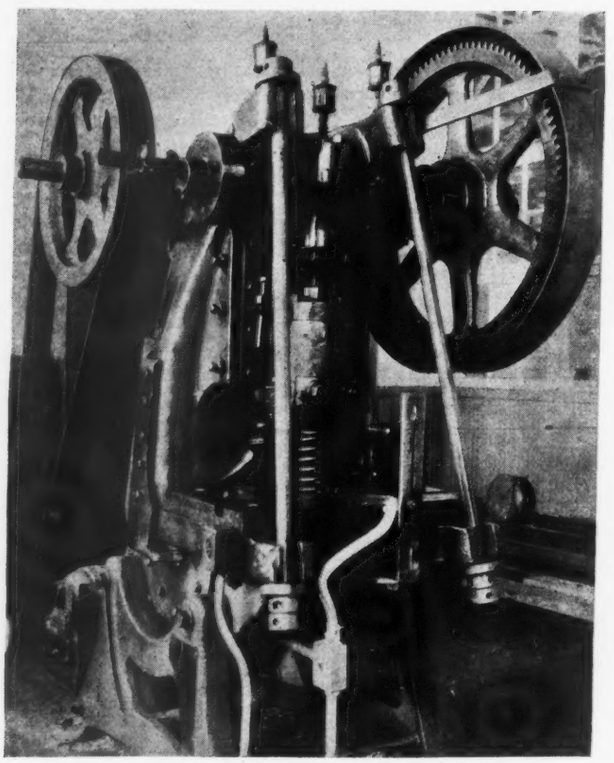
When a new batch is placed on these shelves, there is usually some of the earlier batch still left. So the new goods are marked plainly in a way which indicates that they are to be left untouched until the remnant of previous stock has been used up. No standardized plan has yet been developed to assure the use of the prior serial numbers, but three different methods are now in use. One is a strip of cardboard on which is stenciled "New Stock"; the employee who places the new stock affixes this sign to the batch and usually pencils in some further directions, such as "Use Top Bins First," or "Finish Bottom Shelf Before Using." The other methods are to slip across the front of the bin a sheet of fiber board or to cover the face of the bin with a piece of wapping paper. In either instance, directions are on the cover.

The plant engineering department is considering devising a simple sheet-metal shutter which might be put in place when the new stock is delivered. But while the present plan lacks the standardized flavor so dear to the heart of methods men, it works very satisfactorily.

•

Photocell Supervises Tests

SOURCE, U. S. Army Air Corps



The Material Division, U.S. Army Air Corps, Wright Field, Dayton, Ohio, uses an old punch press as a fatigue testing machine for shock absorber springs. The equipment operates 24 hours a day, and a small counter indicates the number of times the spring is compressed. In the past the difficulty was that the spring might break during the night, in which event the machine would continue to operate, recording an incorrect number of compressions.

The problem was solved by installing a photoelectric relay in such a position that the light beam passes beneath the bottom of the plunger when the latter is in its lowest position. In this arrangement, the spring intercepts the light beam and under ordinary circumstances prevents it from falling upon the phototube. When the spring breaks, however, it collapses. The beam strikes the phototube, which actuates a relay to stop the machine.

Data Sheet

A Routine of Factory, Shop, and Pattern Orders

A. **FACTORY ORDERS** are made out by the Order Department when:

1. Machine shop does work for customer.
2. Pattern shop does work for customer.
3. Our products, whether built for customer or for stock.

B. **SHOP ORDERS** are made out by the Engineering Department for:

1. Building or machinery repairs.
2. Jigs or tools.
3. Our product, when cost is required.
4. New design, when cost is required.
5. New machine or equipment for our own use.
6. Miscellaneous jobs.

C. **PATTERN ORDERS** are made out by the Engineering Department for:

1. New patterns.
2. Pattern changes or repairs.
3. Miscellaneous jobs.

Factory Orders

1. Machine Shop Work for Customer

Order Department—When the Machine Shop is to do some work for an outside customer, the Order Department will issue a Factory Order in the usual way, and as usual send this Factory Order to the Engineering Department. After completion of the job the Factory Order is filed in the Order Department.

Engineering Department—From the Factory Order, a Shop Order is made out by the Engineering Department. These orders are tied together by crossing their numbers. The original of the Shop Order is sent to the Cost Department and the shop copy is sent to the Machine Shop. The file copy is retained in the Engineering Department. The Factory Order is then sent to the Shipping Room and is held there until shipment is made. It is then returned to the Order Department for filing.

Cost Department—After the Order is closed and the cost is entered in the Cost Record Book, the cost price is transmitted to the Order Department for establishing the selling price to customer.

2. Patterns for Customer

When the Pattern Shop is to do some work for an outside customer, the routine as specified for "Machine Shop Work for Customer" is followed, except that a Pattern Order is made out by the Engineering Department instead of the Shop Order.

3. Our Regular Products

For our products (built for customer or for stock) the Order Department issues a Factory Order which does not require a Shop Order,—except when it is necessary to get a cost. In such a case, the Engineering Department makes out a Shop Order, and follows the routine as specified for "Machine Shop Work for Customer."

Shop Orders

Engineering Department—Shop Orders are made out by the Engineering Department and must show the proper charge account. The original is sent to the Cost Department and the shop copy is sent to the Machine Shop. The necessary drawings should accompany the shop copy of the order. The file copy is retained in the Engineering Department.

Machine Shop—The Shop Order is executed by the Machine Shop. The shop records the Shop Order number on Job Cards for all labor, and on Purchase Requisitions for all outside purchases. The Purchase Requisitions and Shop Order are tied together by crossing their numbers. The shop also records on the Shop Order all material taken out of stock, giving weights of castings, bar stock, etc., if possible. When the job is finished, the shop notes date of completion and sends the Shop Order to the Cost Department. *(Continued on following page)*

Data Sheet

A Routine of Factory, Shop, and Pattern Orders

(Continued from preceding page)

Cost Department—Job cards are turned in weekly to the Cost Department and all labor is posted on the Shop Order. Invoices on Purchase Requisitions for material purchased outside are also recorded on the Shop Order. Orders can be closed only upon receiving copy of Shop Order from the Shop, indicating date of completion. Shop Order should be checked with original for Invoices against Purchase Requisitions and material taken out of stock. The cost is entered in the Cost Record book.

Routine of Shop Orders for Manufacturing Machines and Equipment for Our Own Use

Engineering Department—A Shop Order is made out by the Engineering Department. This Shop Order and the Bill of Material for the job are tied together by crossing their numbers. The original of the Shop Order with a Bill of Material is sent to the Cost Department. The copy of the Shop Order with a Bill of Material and with all necessary drawings of parts is sent to the Machine Shop. If patterns are required for the job, the necessary Pattern Orders are made out by the Engineering Department. The Shop Order and Pattern Order should be tied together by crossing their numbers. The file copies of the Shop Order and Pattern Order are retained as usual in the Engineering Department

Cost Department—Before closing the Shop Order, it must be checked with the Bill of Material by the Cost and Engineering Departments for any omissions or changes of material.

If there is also a Pattern Order applying to the job, its total cost is memoed on the Shop Order, its number being crossed with the Pattern Order number, so that the Shop Order will show the *entire cost*. The cost posted in the Cost Record Book from the Shop Order must not include any item previously posted,—such as the cost of a pattern which has already been recorded in the Cost Record Book from the Pattern Order.

For additions to a job already closed, the Engineering Department will make out a new Shop Order, on which reference is made to the number of the previous Shop Order. The Cost Department will memo the additional cost on the previous Shop Order.

Routine of Shop Orders for Jigs

The classification of "Jigs" includes drill jigs, molding jigs, fixtures, and reamers.

Engineering Department—When a jig is to be made in our shop or is to be purchased outside, a Shop Order is made out by the Engineering Department. This Shop Order will carry the Drawing and Pattern Number of the jig. A tag to be attached to casting is also furnished by the Engineering Department. This tag shows the Shop Order number.

Machine Shop—Purchase Requisitions for material required to manufacture the jig (castings, drill-jig bushings, set screws, etc.) must carry the Shop Order number. The tag furnished by the Engineering Department must be attached to the casting and must follow the jig in the various operations through the Shop. The tag instructs the machinist to charge on Job Cards all time put on the jig and gives also the Shop Order number.

If the jig is to be purchased outside, the Shop Order number must appear on the Purchase Requisition.

Jigs

A. Jigs, not usually replaced due to wear, are to be capitalized, and the usual depreciation applied annually.

B. Jigs, frequently replaced due to wear, should be considered as small tools.

Pattern Orders

Pattern Orders are made out by the Engineering Department and the shop copy is sent to the Pattern Shop, together with the necessary drawings. The routine for a Pattern Order is the same as for a Shop Order.

DAVID FLIEGELMAN, Coppus Engineering Corporation, Worcester, Mass.

You want to know

and the editors will be glad to tell you . . . . .
more about the things mentioned on this page

• AN ALUMINUM PAINT that spreads better is made by exploding the powder lumps that are bound to form in ordinary processing.

• WOOD BORERS had better keep away from rustic furniture, fences, log cabins that have been treated with a newly developed non-caustic, non-corrosive preparation.

• INSERTS of steel, iron, copper wire, nickel silver tubes, porcelain, pressed paper, wood, wood pulp, are all pinch-hitting in zinc die castings.

• FRESH SILVER has a reflecting rate of 93 per cent, but it falls off rapidly. The new electrolytic brightening process has stepped aluminum's reflectivity rate up to 85 per cent—and the brightness is permanent.

• TWO UNIVERSITIES, one correspondence school, offer courses in practical guidance to inventors; also to factory executives who would safeguard machinery and products, avoid disastrous clashes through patent infringement.

• SHREDDER, newly announced, will turn magazines, newspapers, tissue paper, scrap cellophane, etc., into paper excelsior at the rate of 400 pounds an hour.

• SHEFFIELD (England) cutlery manufacturers have developed a process for electroplating tableware with rhodium. It is harder than silver, hence wears better. Needs no cleaning.

• RUBBER-TIRED COOLER can be moved from room to room. Quiet as an ordinary fan, no bigger than a console radio, but big enough to dehumidify and cool an ordinary room.

• CLEANING PROCESS, new, removes insoluble dirt from cold-rolled steel and other metals without tumbling, brushing, or other mechanical action.

• NON-SLIP rubber treads, in sizes ready to apply to old and worn stairways, now come in colors.

• STEAM-JET refrigerating systems which air-condition the British Empire Building and La Maison Française at Rockefeller Center, New York, have a combined capacity equivalent to 1,360,000 pounds of ice, more than enough to fill the ice-box requirements of a city with 180,000 inhabitants.

• LACQUER so tough and flexible that it stands up even on a bowling pin, so hard that it picks up no dirt, is now to be had.

• LEATHER BELTING, its evolution, is an attractive booklet which traces history of belts from early Egyptian beginnings up to present day.

• CREAM CHEESE can now be packaged and cured in cans. Normal ripening is made possible by a valve that lets out gases, prevents entrance of air.

• PORTABLE INSTRUMENT, operating on Wheatstone bridge principle, measures electrical conductivity and determines moisture content of dried fruit within one per cent of the exact value.

• MOLDED PLASTIC JARS have a new rooter in the person of a California manufacturer. Tests conducted over a period of five months proved them eminently satisfactory containers for his shaving cream.

• PAPER NAILS are announced. Hydraulic pressure makes them so tough they can be driven into a hardwood plank without breaking or bending. If you need a nail that is a non-conductor of electricity, this is it.

• MIXING KETTLE, made of special nickel-bearing alloy, showed no loss of weight after being subjected to 119 days of uninterrupted testing with boiling sulphur chloride. Similar kettle of good gray iron, similarly tested, lost 11 per cent of its original weight.

• SEW-ME-ON premiums are being used by a candy manufacturer to induce the ladies to buy his caramels. Premium coating improves appearance and saves the package from showing fingermarks and store dirt.

Where six-hour days have squeezed out the conventional lunch hour, this rubber-tired cafeteria solves the problem of taking meals to workmen. It's made of aluminum alloy, is easily handled by one person, has everything an industrial dogcart needs

• HOME-STUDY COURSE in air-conditioning at Eastern university has attracted students from 36 states, from Australia, Russia, France, China, and Canada.

• TIGHT-WRAPPED waxed package is moisture, sift, and insect proof. The wrapper is glued to the carton, remains part of it after opening. Also, the wax and product are displayed in transparent-cellulose wrapped package. The ladies appliqué the premiums on coats, sweaters, cushions; presumably eat the caramels.

• MAGNESIUM-BASE ALLOYS, lightest of structural metals, are described in a new data book available

(Continued on advertising page 44)

Factory Management *and* Maintenance

A consolidation of *Factory and Industrial Management* and *Maintenance Engineering*

L. C. MORROW, Editor

MAY, 1934

Capital Investment and Economics

MANY people, and not all of them laymen by any means, simply can't see any justification for an increase in capital goods.

They advance the arguments that we already have too much capacity; that more efficient equipment means less employment; that payment for the additional or new equipment must come out of savings in labor; that labor represents so small a part of manufacturing cost that not enough such savings can be taken. To all of these arguments there are answers.

The too much capacity argument does not seem to admit of any great upward change in standards of living, does not recognize that people are actually in want. Surely it is not difficult to imagine a consumption of goods several times as great as now exists. Nor does the argument define the kind of existing capacity. Is it wasteful or efficient? Does it produce at costs that will tend to bring about the widest distribution?

In general, efficient equipment does not mean less total employment. Individual improvements may cause temporary displacements, but deliberate inefficiencies, planned wastes, decrease useful production per unit of man work, lessen the amount of potential per capita possessions. If the principle of retention of inefficient equipment were carried to absurdity we should be in a sorry plight.

The purchase or non-purchase of capital goods should be justified by individual cases. In all instances the opportunity for reducing labor cost must be considered. If labor costs are 50 per cent of the manufacturing cost, it is likely that a large proportion of the saving will be made from labor. If labor costs are from 4 to 10 per cent, little saving can be made. Labor costs do vary between the high and low figures given, and they are important or not according to their size.

But there are other costs from which savings can be made. An important one is the cost of investment in inventory. Others are costs of materials, power, heat, light, and floor space.

Nor must we overlook the less tangible, but vital cost of lack of progress. It would be only by a peculiar kind of economics that we could justify protection of inefficient capital investment. For the sake of progress we must admit increased capacity in the form of entire new plants as well as individual machines and methods. If Mr. Doe can put into operation a factory that will produce automobiles that the public will buy, and can make them at one-third of present costs, it is in the public interest that Mr. Doe be permitted to do so, despite existing capacity capable of great volume.

The natural conclusions from this line of reasoning are that plant and equipment efficiencies must be improved wherever possible; and that restrictions as to additional capital investment should not be adopted, either by government or industry.

Political Obstacles, Legislative Threats Retard Revival

CAMPAIGNING for revival of durable goods industries is under way. As pointed out in these columns many months ago, the greater part of unemployment exists in the durable goods industries. Recently both the Durable Goods and Consumer Goods Industries Committees, appointed at the General Code Conference, reaffirmed this statement.

Said the Consumer Goods Committee: "We should be remiss in our duty as a committee were we to fail to draw attention at this time to the emphasis which, in our judgment, rightly belongs upon clearing the way for confidence and for revival of the capital goods industries. The first step is removal of political obstacles and legislative threats." Obstacles enumerated were the Wagner bill (Industrial Disputes Act), Connery bill (30-hour week), and the Securities Act of 1933.

The Durable Goods Committee reports: "In the durable goods industries it is estimated there are about 5,000,000 unemployed. The requirements for even partial recovery in these industries are: (1) The restoration of confidence in the government's future policies; (2) the opening up of channels for the free flow of private savings into normal investments; (3) the breaking open of the frozen mortgage situation and the creation of new forms of real estate financing."

Thus the two committees concur concerning the retarding influence of proposed legislation, and the necessity for revision of the provisions of the Securities Act of 1933.

Without questioning the motives back of the legislation referred to, we believe it extremely important that the recommendations of these two committees be followed at this time in order to consolidate existing recovery gains, make additional necessary gains possible.

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High Time to Countermand "Don't Buy" Orders

"DON'T BUY" orders, issued to plant operating men, were a serious business deterrent during the depression. They were issued with such vehemence as to be lastingly impressive; brought about the desired economies, small as well as large; fostered the habit of depending upon saving as a panacea.

It is said that a man who does the same thing for thirty days running is almost certain to do it on the thirty-first day, even though the need for the action no longer exists. If thirty days will bring about automaticity, how about three years? For that length of time have plant men been saying "No" to salesmen; the response has become automatic.

Now it's time for the men who issued the "don't buy" orders to countermand them. Not just for the sake of giving some worthwhile salesman or company a sale; plant operating men must now get the habit of buying instead of not buying for economies. Unqualified "don't buy" orders are out of place on the upward swing.

Distribution Costs as Source of Economies

OFTEN the statement is made that there is so much opportunity to cut distribution costs that opportunity to further cut manufacturing costs is insignificant in comparison.

With many commodities, distribution costs represent a large proportion of the selling price. But that fact alone does not constitute assurance that distribution costs can be slashed right and left. No doubt the law of diminishing returns applies in the relationship between order volume and money spent for distribution (advertising, selling, promotion).

A management engineer of our acquaintance tells us that in fifty years of work with distribution costs he has become convinced that the cost of distributing a product to other manufacturers or to retailers must be at least equal to the sum of the amounts necessary to take care of return on capital investment, development and expansion, contingencies and new markets, cash surplus, and income tax.

It is desirable that distribution costs should be subjected to the same searching analysis that industry is accustomed to give to manufacturing costs. But drastic pruning should take place only after factual evidence of waste.

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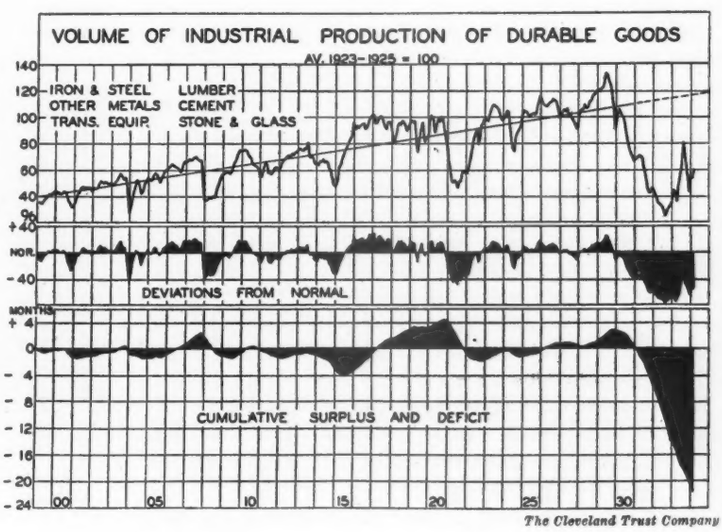
Read in connection with chart below: Durable goods, as distinguished from consumption goods, are those made of the lasting materials. In the main they are not bought at retail, and in large part they are paid for by borrowed funds secured from bond issues, mortgages, and installment notes.



The Cleveland Trust Company

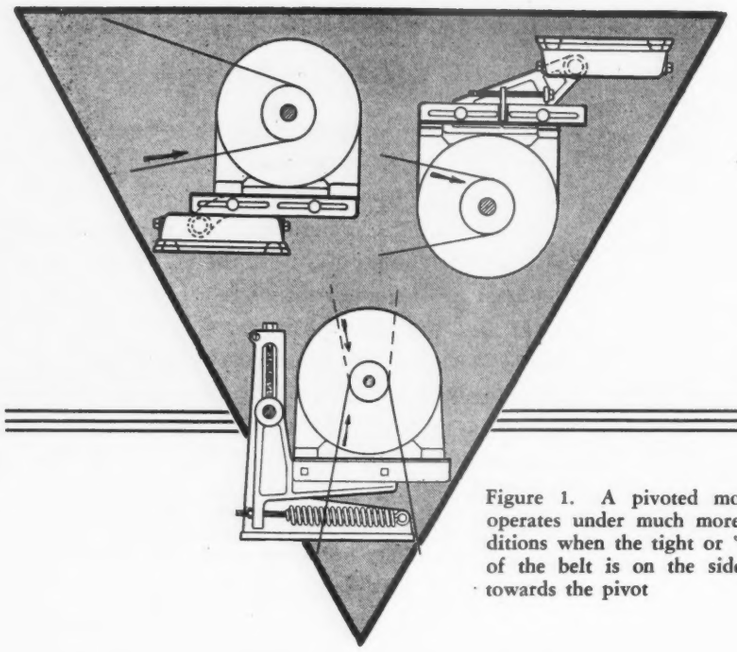


Figure 1. A pivoted motor base drive operates under much more favorable conditions when the tight or "pulling" strand of the belt is on the side of the pulley towards the pivot

Robert W. Drake
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De Kalb, Ill.

Laying Out Group Drives

Power losses and production needs were discussed in March. Now the viewpoint shifts to new installations and extensive alterations

WHERE standard open motors are to be used, they should be mounted high enough so that as little foreign matter as possible (dirt, chips, oil, coolant, and material in process) will enter the airgap or be deposited on the coils. In case liquids may drip on the motor from the floor above, dirt-proof "pump type" motors may be used. If it is desired to use standard open motors for reasons such as interchangeablity, standardization, or because such motors are available without purchase, an inverted pan mounted above the motor base will be found practically as effective as a drip-proof frame, provided the pan is of ample dimensions.

Size of Groups

The use of anti-friction bearings in counter-shaft hangers and loose pulleys is advisable. In new work it is advisable to use anti-friction bearings in groupshaft hangers. Such bearings may reduce oiling labor and lubricant requirements by as much as 80 per cent and will help to save power.

Do not make groups too large or too small; from eight to twenty machines in a group is about right, depending upon the length or groupshaft required and the average power required per machine.

Use a separate motor on each shaft instead of cross-belting two or sometimes more parallel shafts together.

Where the use of vertical belts is unavoidable, consider employing devices that are available for automatically maintaining the requisite tension to assure pulley grip in spite of belt elongation with time or elastic elongation with load.

New Ideas about Belt Speeds

Group transmissions should be designed liberally. The load on most groups increases as the years pass, and heavy-duty, high-output machines replace lighter, obsolete units.

For more than 30 years almost every writer on the subject has stated that the most efficient belt speed lies somewhere between 4,000 and 5,000 feet per minute. These statements are based upon the fact that a belt operated under tensions proportioned to give reasonable life will carry about as much load at these speeds as it will at any higher speed. The tacit assumption is also made that the cost of belt replacement, slip and creep losses, and the annual maintenance cost are the principal charges to be considered in determining the best belt speed. On that basis the statements are correct.

Only during the past five years has any considerable attention been given to the windage losses of the pulleys

and of the belt itself. These losses, entirely negligible at low belt speeds, increase about sixfold for each doubling of the belt speed and are far from negligible at a speed of 4,000 to 5,000 feet per minute. The windage loss on pulleys and belts of a drive designed to transmit an average load of 50 horsepower, with momentary peaks of 100 horsepower, using a conservatively designed drive belt from a motor to a groupshaft, will at a belt speed of 5,000 feet per minute amount to from 1 to 3 horsepower, depending upon the pulley centers (3 to 30 feet) and the type of pulleys chosen. If the same drive were designed for operation at 3,000 feet per minute, the corresponding windage losses would be on the order of $\frac{1}{2}$ to $1\frac{3}{4}$ horsepower.

For an average condition, say 15-ft. pulley centers, the cost increase due to the larger belt, pulleys, shafting, and bearings required at the lower speed would be approximately $25, varying somewhat with motor speed. The difference in drive losses amounts to $\frac{7}{8}$ horsepower, and is due principally to the difference in windage losses of pulley and belt, but there is some offsetting difference in belt creep and bearing friction losses. The net difference in losses, $\frac{7}{8}$ horsepower, would cost $35 a year in a large plant, perhaps as much as $150 a year in a small plant. It is evident that such an annual charge is by no means negligible in determining the most efficient speed at which to operate belts, and that the assumptions which have been generally accepted for so many years must be revised.

Welcome News

When due consideration is given to these losses it will be found that the best belt speed is nearer to 2,500 than to 4,500 feet per minute. The exact value depends upon such factors as unit cost of the power wasted in losses, and the capacity of the drive.

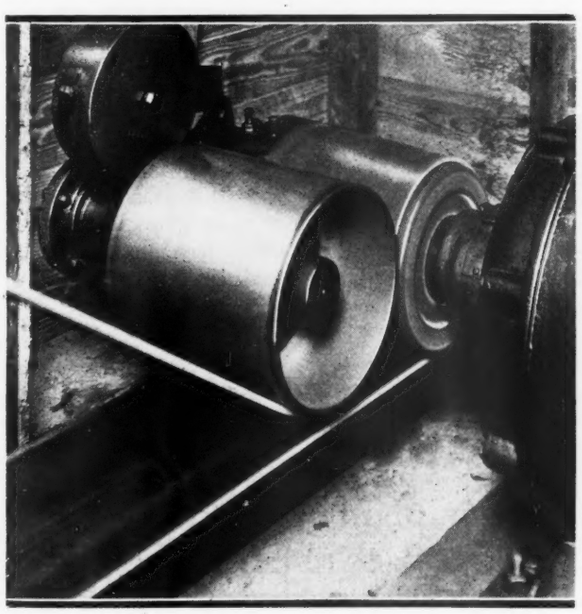

Figure 2. The idler pulley of this drive is of ample size, but if it were farther away from the motor pulley the life of the belt would be doubled and the capacity of the drive reduced only 10 per cent or so

This is welcome news. All of these years when we have been told to design our drives for a belt speed of 4,500 feet per minute, physical limitations have prevented compliance in nineteen cases out of twenty. It is a grand and glorious feeling to know that our humble efforts have in many cases struck nearer to the truth than the theorist's analysis.

Layout Difficulties

Nowadays the congestion on the ceiling of the factory work space frequently makes the conventional long-center drive between motor and groupshaft impracticable. With raw-material and finished-product conveyors, a half-dozen piping systems, and ventilating ducts to be accommodated, a clear space of 10 to 15 feet "across traffic" cannot be arranged. To add to the difficulty, the designer would prefer to use motors of 1,200- and 1,800-r.p.m. speed because of superior performance, lower losses, and lower cost. A short-center drive is usually impracticable if the conventional open drive is to be used, because of the great disparity between driving and driven pulley diameters that is unavoidable when high-speed motors drive groupshafts operated within the ordinary speed range.

There are now available two devices that automatically maintain the belt tension necessary for pulley grip in such a drive without relying upon the sag in the belt to absorb the slight elongation that is due to stretch and formerly required longer centers.

The simplest of these devices is the pivoted motor base. The cost of the necessary base is largely offset by the decreased first cost and replacement cost of the shorter belt and by the fact that no sliding base need be purchased with the motor. The required belt tension is maintained by balancing a part of the weight of the motor against the belt, as is evident from the illustration. The portion of the weight so balanced is adjustable by changing the motor position. This drive is well suited for the pulley ratios commonly required for driving groups. For long, trouble-free service the sizes of the motor pulley and driven pulley should be chosen so that the diameter of the motor pulley will not be less than the motor manufacturer's recommended minimum, preferably not less than the manufacturer's standard pulley diameter. Wherever the pulley diameter is less than the latter figure, or the driven pulley is more than four or five times the diameter of the driver, the drive should be planned so that the tight or working strand of the belt is between the pulley and the hinge pin, as shown in Figure 1. This arrangement is essential also for drives that involve extreme momentary starting or running overloads.

Pivoted Bases

The pivoted motor base drive has another advantage over the ordinary sliding base mounting. In case replacement is necessary because of motor failure, the distance between the mounting arms can be adjusted quickly. The holes are slotted in the other direction. Hence any available motor of suitable size may be quickly mounted in place of the motor that has failed and the pulleys aligned without the necessity of chang-

ing bases—a saving of an hour or two in delay time, if an identical motor is not in stock. Of course a very much larger motor may exceed the range of base adjustment available. For this reason it may be advisable to install a base that is one size larger than necessary. Such foresight also avoids the necessity of changing the base if growth of the load necessitates a larger motor.

Idler drives, Figure 2, are preferable when there is extreme disparity in pulley diameters, say, above 6 to 1 for drives with severe load fluctuations or 8 or 10 to 1 on drives where only moderate overloads will occur and the motor pulley can be made ample in diameter. In

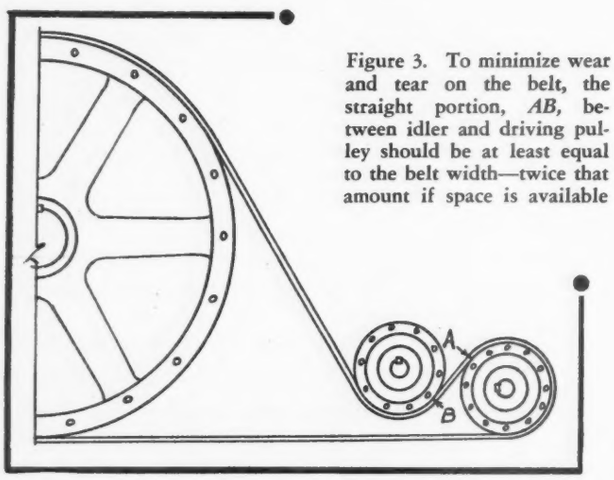

Figure 3. To minimize wear and tear on the belt, the straight portion, *AB*, between idler and driving pulley should be at least equal to the belt width—twice that amount if space is available

this case the necessary belt tension for pulley grip is maintained by the weight of the idler, or of the idler and additional weight supplied for the purpose. The belt tension may be adjusted to suit the requirements by changing the amount and position of the loading weights.

Idler Life

Such drives will carry occasional extreme overloads with a lower average tension in the belt during operation at normal load than is the case with the pivoted motor base drives. With some idler installations belt life has been unsatisfactory because of the effect of the severe S bend in the belt. This difficulty may be eliminated by using an idler with a roller pulley of ample diameter, as large as or larger than the driving pulley, and by locating the idler pulley at a sufficient distance from the driven pulley to give ample space for relieving the diagonal stresses caused by the crown on the driving pulley.

For this reason the straight section of the belt, *AB* in Figure 3, should never be less than the belt width and may well be twice that, if space is available. Admittedly this recommended idler position reduces somewhat the maximum overload capacity of the drive, but the sacrifice seldom exceeds 10 per cent, whereas the advantage of the recommended idler position and ample idler roller diameter is frequently a large increase in belt life.

In the idler installation there is no limit whatever upon the relative diameters of the driven and driving pulleys. It is perfectly satisfactory for either one of them to be 100 times as large as the other.

These two drives are well worth considering for use in driving every group. Properly applied they will eliminate belt slip and result in a value of creep that is commonly well below 1 per cent. They eliminate almost entirely the need for belt take-up. Both give best performance when operated with endless belts in which the joints have been carefully made to avoid a thick or stiff spot in the belt which may cause "jumping."

Quick Changes

To minimize delays in replacing group motors in case of failure, they should always be located where there is a clear space beneath. The old custom of placing the motor near the center of the shaft often violates this rule. It is true that a motor mounted near the end of a shaft occasionally necessitates larger shafting toward one end, but the slight additional cost is warranted. If the motor and equipment for raising it must be carried over machines, and perhaps raised from a temporary platform over them, or if special equipment that is available, such as a high-lift truck or platform on casters, cannot be used in making a motor change, there will be greatly increased delay. In a plant in which individual machine loads are heavy and many group motors must be of 75-hp. or larger rating in order to avoid having too few machines in a group, the time required to change a motor with hand tackle will be excessive, if the manufacturing methods are such that delays are as expensive as is usually the case. In such instances, it is customary in many small shops to install the replacement motor on the floor, in an emergency, and lace a belt. Changing of the motor may then be delayed until night or Sunday.

Many larger plants have found it advisable to provide the maintenance department with a specially equipped, high-lift truck which will quickly place the motor in position. When such a truck is equipped with pulley and pinion pullers and such tools as are necessary for changing the motors, the operation that consumes the most time is the selection and proper loading of the correct replacement motor.

There is another good reason for locating a motor driving a group over an aisle or other open space. Motors that are inconveniently located slow up the inspector and the oiler, with the result that they can handle fewer motors. Frequently the operator of the machine beneath stops work while inspection is in progress. He doesn't fancy breaking the fall of a screw driver or wrench, and he prefers to choose his own hair oil. The result is unnecessary loss of time all around.

A third article will close the subject with a discussion of a number of points that must be considered in a fairly modern plant, where detailed changes capable of yielding attractive savings are the consideration—Ed.

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Better plant utilization is the motive back of extensive operating changes made by The Apex Electrical Manufacturing Company. A June article

Getting Costs—and Keeping Control—of Maintenance

Summarizing and analyzing the maintenance cost data in order to keep control of maintenance expenditures

Carl G. Wyder

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WE HAVE until now observed all the primary forms for obtaining control of all work and collection of all data, which forms have all been returned to the engineering office. There follows a description of the disposition of these forms in connection with the use of other forms developed for the accumulation of the intermediate and final records. Returning to the time of issue of a shop order (not a shop sub-order) the clerk also introduces an envelope form, of 20-point thickness material, called the *Shop Order Cost Summary,* Figure 7, which he marks with the order number and date of issue, and places in numerical order in another special two-partition box file known as the *Cost File.* Only one envelope is issued for each order number regardless of the number of divisional orders; it is never issued for a shop sub-order. This envelope is designed to hold the material reports after they have been priced by the purchasing department, and to hold the *Shop Order Labor Cost Summary* which will now be described.

Figure 7. Manila envelope. Size 11¾x9¼ inches

Form 7554-33

SHOP ORDER No. K
DATE ISSUED
DATE COMPLETED
DATE APPROVED

SHOP ORDER COST SUMMARY

DIVISION	LABOR	MATERIAL	TOTAL	REMARKS
A - Machine Shop				
B - Pipe Fitters				
C - Electricians				
D - Construction				
E - Carpenters				
F - Painters				
GRAND TOTAL				

Shop Order Labor Cost Summary

This form, Figure 8, is introduced simultaneously with the issue of a shop order or a shop sub-order. The order number is entered in the upper right-hand corner, and it is thereupon filed either in the cost summary envelope just presented (for a shop order) or in numerical order in the second partition of the cost file (for a shop sub-order). There is no purpose in this separation other than convenience of handling. The application of this form, which is the same in both cases, requires a knowledge of the disposition of the daily time card, which begins the office work for the day.

The lot of daily time cards, collected the night before from the base shops are first simultaneously "rated" and checked for omissions and proper markings. They are then reviewed to detect on the extreme right-hand side the presence of a check mark previously described as denoting a newly active order. For each order so indicated the clerk transfers the copy in the control box from the "new" to the "active" partition, and checks the numeral at the top of the order to indicate the date of action. The daily time cards are then extended for elapsed job time (to the nearest quarter-hour), and wherever felt necessary the total time is reconciled with the regular plant pay-card time. The cost of each entry is

Part I, published in March, described the plant in which the system is in operation and set forth the principles upon which the system is based. Part II, treating of the initiation of the order, following it through the shop, and building up the costing information, was published in April.

SHOP ORDER LABOR COST SUMMARY

SHEET..... OF.....

GRAND LABOR TOTAL $..... SHOP ORDER NO. .....

DATE	A Machine Shop	B Pipe Fitters	C Electricians	D Construction	E Carpenters	F Painters			REMARKS

(FIGURE 8)

..... SHOP ORDERS DATE .....

DIVISIONAL LABOR COST SUMMARY

ORDER NO.	A	B	C	D	E	F		

(FIGURE 9)

ENG. DEPT. ..... SHOP ORDER ..... DATE

DEPARTMENTAL SUMMARY

DEPT.				DEPT.			
1				32			
2				33			
3				34			
24				55			
25				56			
26				57			
27				58			
28				59			
29				60			
30				61			
31				62			

(FIGURE 10)

Figure 8. Size 8½x11 inches

Figure 9. Size 8½x13 inches

Figure 10. Size 8½x13 inches

then calculated by the use of a "ready-reckoner" table made commercially for this purpose, resulting in a dollars-and-cents figure.

The cards are then cut along the heavy lines into strips by a cutting board with two measured stops which greatly facilitate the operation.* The upper tabs and lower blanks are discarded and destroyed, and there remains a pile of registered strips, each identifiable by an order number, on which a contributing cost is available. These strips are now sorted into three main groups, representing shop orders, shop sub-orders and *NP Orders*. The last-named group will be described later.

Taking now the first group, representing shop orders, the strips are sorted according to order numbers, and each order number is then subdivided into the various engineering divisions participating. These divisional units are each totaled (with the use of a Burroughs- type adding machine), and the result is entered by order number index on a mimeographed work sheet called the *Divisional Labor Cost Summary*, Figure 9. Later it is a simple procedure to post this analysis to each respective labor cost summary, which will consequently reveal the daily progress and accumulated labor cost of all divisions affecting that order. With the recollection that in the meantime there have been steadily flowing in the material-used reports which have been placed in the same envelope, it will be evident that the progressive cost of any shop order can be made available within a few minutes.

Referring again to the work sheet (Divisional Labor Cost Summary), it is now analyzed, by an inspection of the order numbers, according to the new *(N)* or repair *(R)* labor cost of each operating department, and the results are entered on a second work sheet known as the *Departmental Summary,* Figure 10. This sheet has been prepared with headings of *N* and *R* inserted in the blank box spaces at the top. The sum of these two totals (*N* plus *R*) for each operating department is then placed along the borders of the work sheet, and as is done with all other work sheets, the horizontal and vertical totals are checked and reconciled with the previous sheet.

A review of the results from the beginning of the analytical sorting of the first group of shop order strips shows a tabulation on the two work sheets of the total labor costs of the day (for shop orders, of course) according to (a) all individual orders, which are further analyzed to show divisional participation, and to (b) all operating departments, which are also subdivided to show the ratio of new to repair work.

Work for One Clerk

Returning now to the second group of strips, representing shop sub-orders, this group is treated in exactly the same fashion as the shop orders, yielding two more work sheets of similar information. This whole procedure of sorting strips has been greatly simplified by the design of open-end sorting box tiers. For a quantity of strips derived from about 100 daily time cards no more than 20 minutes of actual total sorting time is required. The task of analysis also is considerably alleviated by the use of the adding machine, and does not require more than an hour and a half per day. As a matter of fact, the entire routine described in this article aside from the issue and care of the shop orders can be

*Manufacturing Costs and Accounts, by A. Hamilton Church, page 462, McGraw-Hill Book Company.

easily completed by one clerk within an eight-hour day.

Reference has been made above to a class of *NP* orders. *NP* orders (derived from the word non-productive) have been devised to enable the performance of work of a definite routine character (such as oiling) on a standing-order basis, thereby guaranteeing adherence to the elementary principle that all labor must be authorized by an order number, and yet removing any red-tape hardship which the formality of a request would otherwise impose. The numbering of an *NP* standing order follows in part the general scheme outlined for shop orders, and is derived by prefixing with the letters *NP* the number of the department in which the work is done, and suffixing this result with the letter of the workman's divisional identification. A standing order number *NP10A* would indicate, for instance, work performed by the machinist division in department No. 10.

To Avoid Red Tape

A stand-order does not, of course, require any formal written authorization. Its application is principally found in the work of men definitely stationed in one or more departments where constant mechanical attention or adjustment is necessary. The use of the *NP* order has also been extended to eliminate another otherwise annoying situation which occurs in general maintenance or repair work of small consequence, such as the repacking of a valve, or the replacement of a light bulb.

The established rule is that all work (excepting new) of less than two man-hours' labor may be executed under the authority of an *NP* standing order. The abuse of the standing order is limited by this rule as well as by its definitely scheduled departmental applications mentioned above. Should the amount of *NP* labor tend to increase substantially over an easily derived "bogey" schedule, the detailed labor-time and cost records will reveal not only the transgression but also the transgressor, and corrective executive control can then be intelligently exercised.

This, then, is the source of the third group of *NP* order strips mentioned above in the three original main divisions of time-card strips. This group of strips is sorted according to department numbers, then further subdivided into the engineering divisions, which units are now totaled and entered on another departmental summary work sheet. Two pages are required for the six divisions, with box headings, of *A, B, C,* or *D, E, F,* as the case may be. Each department is now totaled in the border; sheets are checked like all preceding ones.

The analysis of all three original groups of strips is now complete. The strips are no longer needed and are gathered together, still keeping the three groups intact and in order of their final assortment, so that at any time in the near future a re-analysis or check-up may be easily made. The bundle is dated and filed away chronologically; at the end of the third month following it is discarded with the monthly accumulation.

Monthly Labor Cost Summary

We have now the six pages of work sheets containing a complete labor analysis of all the direct labor costs in the engineering department for one day. Two of them, the divisional labor cost summary sheets, are used for posting the individual shop order and shop sub-order costs to their respective labor cost summary sheets in the cost file as previously suggested. The other four, the departmental summary sheets, bear an analysis of these same costs according to operating departments. The intrinsic value of this operating analysis is not apparent until a side-by-side comparison of daily performances is made available, which is effected by transferring these data to the more formal *Monthly Labor Cost Summary*, Figure 11. This form is made from a tracing on heavy blue-on-white print paper, and continues the same analysis for a month's period. The horizontal rulings indicate operating departments; vertical, days of the month.

In order to preserve the benefits of the detailed analyses that have been made on the work sheets, they are transferred to eleven of the monthly summary sheets; two sheets are used to show the "new" and "repair" analysis of both the shop order and shop sub-order; one sheet shows the total *NP* standing orders, which are essentially all of a "repair" nature; the six remaining sheets bear the individual divisional analyses of the *NP* standing orders shown on the fifth sheet. With this record there is no difficulty encountered in checking or locating abuses of the standing order privilege.

After work sheets have been posted, they are filed, then discarded the third month following.

Monthly Report

The climax of this successive development of forms occurs at the close of each month, when the above eleven

Figure 11. Size 33x20¼ inches

TEXTILE DYEING AND PRINTING CO. OF AMERICA INC.

MONTHLY LABOR COST SUMMARY

FOR MONTH OF..... CLASSIFICATION OF WORK:.....

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	MONTHLY TOTAL	REMARKS
DEPT. 1																																	
2																																	
3																																	
4																																	
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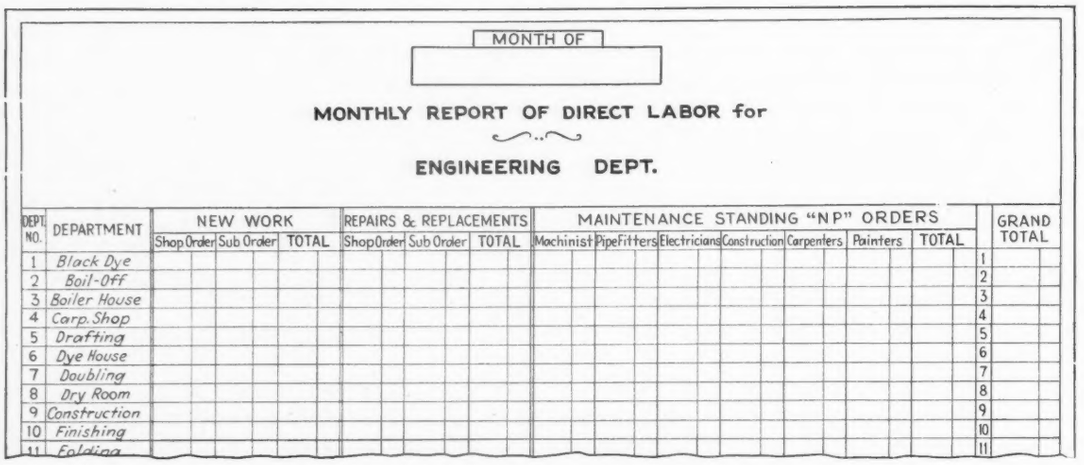


MONTH OF

MONTHLY REPORT OF DIRECT LABOR for

ENGINEERING DEPT.

DEPT. NO.	DEPARTMENT	NEW WORK			REPAIRS & REPLACEMENTS			MAINTENANCE STANDING "NP" ORDERS							GRAND TOTAL
		Shop Order	Sub Order	TOTAL	Shop Order	Sub Order	TOTAL	Machinist	Pipefitters	Electricians	Construction	Carpenters	Painters	TOTAL	
1	Black Dye														
2	Boil-Off														
3	Boiler House														
4	Carp. Shop														
5	Drafting														
6	Dye House														
7	Doubling														
8	Dry Room														
9	Construction														
10	Finishing														
11	Folding														

Figure 12. Size 18¼x16 inches

monthly labor cost summary prints are totaled and checked horizontally and vertically, and the results are posted to the single *Monthly Report Form,* Figure 12. An inspection of this form shows it to contain information which is sufficiently condensed for executive perusal, and yet so fully comprehensive in its scope as to afford a valuable tool not only to the plant engineer in the management of his department, but also to the general manager in his broader capacities. A file containing such monthly reports for several years back is likely to be indispensably informative in shaping the general maintenance policies of the company for several years ahead.

There requires now only a brief but nevertheless important description of the disposition of all forms used in connection with the completion of a shop order. It has been previously shown how the original copy of the order, when completed, was dated and signed by the foreman and returned to the engineering office. When this occurs, the file copy located in the active partition of the control box is dated at the top numerals and moved over to the completed partition. The original copy is sent to the operating executive who requested the work, to secure his acceptance signature.

The purpose of this acceptance is two-fold: first, it advises the operating executive that the job is completed; second, it assures the plant engineer that the job has given full satisfaction, thereby preventing the premature closing of unsatisfactory jobs, on the one hand, and acting as a receipt, on the other, against operating changes desired after an acceptance. In the instance of an order issued to more than one division, the office copies are transferred in the control box in the same manner as for one division, and the completed divisional copies are withheld for approval until all copies have been returned from the base shops.

Costing the Order

Following the acceptance of an order by the operating executive, it is "costed" from the accumulated records in the cost box. In the case of a shop order, the material reports are analyzed divisionally and the results entered in the material column on the outside of the summary envelope. The labor cost summary is also totaled and posted to the envelope, which is now extended to the grand total figure representing the entire material and direct labor cost of the job. This cost is entered on the original order copy in the space provided, which is then submitted to the plant engineer for final approval. It is thereupon filed in numerical order, and the office copy is removed simultaneously from the "completed" partition of the control box and filed departmentally. In the meantime the material reports have been stapled together and replaced in the summary envelope together with the labor cost summary sheets, and the envelope has been filed numerically by order number.

Sub-Order Routine

The routine of the shop sub-order is similar in operation, except that the labor cost summary sheets are filed in a separate drawer from the bulky summary envelopes for convenience of handling. The shop sub-order forms, however, are all filed without separation, in the same drawers with the shop order forms.

The value of this entire filing arrangement as a ready reference is fully appreciated only when the time comes to prepare estimates, check performances, or derive cost data and a host of other technical information not otherwise possible of attainment.

Problem: To build a line of machine tools for short-time delivery.

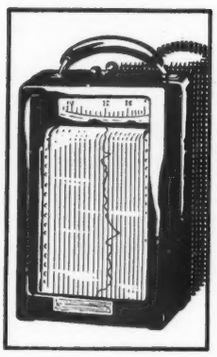
•

Solution: Line production—which keeps several partially completed machines always in process and permits a machine to be finished into any one of a number of types within a few days. A June article

More Business · More Load · More Breakdowns

Check Electrical Equipment *Now*

G. A. Van Brunt
Associate Editor



SUMMER usually affords a welcome opportunity to check and overhaul plant equipment of all kinds. There are several reasons why the electrical systems and equipment in most plants should be examined with unusual case ***this*** summer. During the past few years neglect, stripping of parts, makeshift expedients have been common industrial practice. They lead inevitably to poor condition and unreliability.

Manufacturing conditions also have changed. Once again there is a premium on continuity of service. As a general rule, orders call for smaller quantities, faster deliveries. Arrangement of machines has been changed to give more efficient layout, eliminate unnecessary handling, and provide better control. Need for flexibility in operation and in making changes is greater than ever. As a result, electrical installations that were entirely satisfactory when installed under much different conditions than exist today may be inadequate or unsuited to present demands.

Conditions and requirements in different plants vary widely, but in general any survey of the electrical equipment must seek to determine (1) physical condition; (2) adequacy for present needs and probable future requirements; (3) most economical methods of correcting existing defects or providing such improvements as are needed.

The suggestions that will be given for conducting a survey are necessarily general in character, but they will indicate some of the most important points that require checking. Intimate knowledge of the conditions and requirements surrounding each installation will indicate others.

A survey of the electrical system may well start with the

Substation

Condition—Measure insulation resistance of transformers and feeders. Check resistance of grounds. Test oil in transformers, switches, and circuit breakers. Inspect and if necessary refinish contacts on all circuit breakers, air and oil switches, relays, fuse clips. Check operation of all relays and protective devices. Clean and inspect all insulators and wiring. If meters have been in service for some years, it will be advisable to check them for accuracy.

Adequacy—Equipment may be in good physical condition and yet be obsolete in design, too small or otherwise unsuited to the service, improperly installed, and so on. A check should therefore be made to determine whether or not:

Transformer capacity is adequate for present needs and a reasonable increase in load.

Protective devices can safely interrrupt the maximum short-circuit current that could be developed.

Circuits are properly sectionalized so that trouble on one will not shut down all, or a large part, of the plant.

Arrangement of substation equipment is such that additional circuits or equipment can be easily installed.

Metering facilities are sufficient to provide any data that may be needed for determining costs, checking efficiency of plant operation, or estimation of power losses.

Distribution System

Condition—Measure insulation resistance of all feeders and branches. Check condition of grounds. Inspect all lines to determine condition of conduit and fittings, or insulators. Determine whether all elements are properly protected against mechanical injury, dripping water, excessive moisture, or corrosive fumes.

Adequacy—Many factors will come under this heading, depending on the service conditions and needs. Inspect to determine whether or not:

Feeders are properly sectionalized to confine effects of trouble to local areas.

Protective devices have ability to interrupt maximum possible short-circuit current.

Feeders have sufficient capacity to handle any reasonable or probable increase in load.

Wiring is of a size to prevent excessive voltage drop.

Insulation on all conductors is suitable for service conditions, if exposed to excessive moisture, high temperature, and so on.

The distribution system is laid out and arranged for ease in making connection when power-using equipment is shifted around.

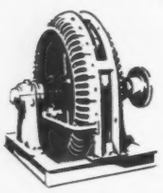
Switching and protective equipment is properly housed

to protect it from injury, dust and dirt, and to safeguard production operators and maintenance workmen from electrical shock.

Two other points that should be given attention are: (1) need for additional metering facilities; (2) advisability of correcting power factor.

Accurate data on the power consumption of departments, individual machines, or groups, make it possible to figure costs more closely and maintain a check on operating time and efficiency. In many plants, measurement of power consumed by departments or other units has been the means of disclosing serious, but hitherto unsuspected, wastes and conditions that needed correcting. Graphic meters, which give a continuous record of power consumption, are especially suited for this service. For example, study of the charts will often show how the load curve can be smoothed out and demand charges lowered by reducing peaks.

No survey of the electrical system can be considered complete without measurement of the plant power factor, in case it is not known, and study of its effect on power costs. A power factor of less than 80 per cent is usually penalized in one way or another. Aside from increasing power costs, low power factor has enough undesirable effects—for example, reduction in capacity of transforming equipment and transmission lines, poor voltage regulation and so on—to warrant investigation with the object of raising it to a desirable value. Usual methods of correcting low power factor involve the use of synchronous motors to drive part of the plant load, synchronous condensers, or capacitors. Considerable improvement can often be made by proper loading of squirrel-cage motors. In any case, selection of the best method of correcting low power factor must be based on a careful study of all of the conditions.



Motors

Condition—Measure insulation resistance. Check air gaps and condition of bearings, windings, commutator or sliprings, brushes, and brush rigging. Determine loads on all motors in order to locate any that are under- or overloaded.

Adequacy—Compare the motors in service with the latest types available from the standpoint of efficiency, power factor (in case of a.c. machines), suitability for load conditions (starting and pull-out torques, speed regulation and range), and protection needed against acid fumes, moisture, dust, or other agents.

Check performance records of motors to determine frequency, nature, and extent of repairs. Estimate probable cost of repairs for the next year or so to determine whether a saving can be made by replacing with a new motor.

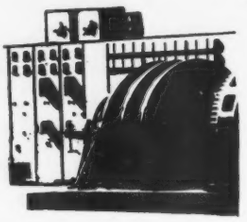
Check motor loads against ratings to determine whether loading can be improved by shifting motors around, assigning the best machines to the most important drives.

Investigate the desirability of replacing some squirrel-cage motors with those of synchronous type in order to raise plant power factor to a more desirable value.

Controls

Condition—Clean and make a detailed inspection of all elements. Check operation.

Adequacy—Study all control equipment in use from the standpoint of what the latest designs offer in reliability, protection required under the service conditions, degree of skill needed for operation, maintenance attention required, suitability in the event that duty cycles or operating conditions must be changed to meet new production requirements and safety to operator and machine.



Determine whether any controls are unsafe or unreliable.

Consider the advisability of replacing manually operated controls with magnetic or automatic types.

Investigate the advisability of using older controls on the less important drives only, putting new controls on the more important services.

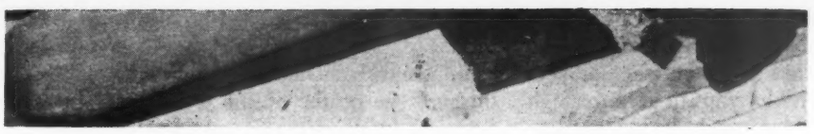
Lighting System

Condition—Inspect all lighting units to determine need for cleaning or relamping (burned-out or blackened bulbs) and to locate broken or distorted reflectors, bare lamps, reflectors fitted with lamps that are too large, improper application of lamps, lighting units mounted in places to which access is difficult or dangerous, incorrect application of reflectors. Measure voltage at socket and check with rated voltage of lamp. Determine voltage drop by simultaneous readings at distribution board and sockets farthest removed. Note color and condition of walls and ceilings to determine need for cleaning or repainting a light color.

Adequacy—Measure foot-candle intensity at workplaces and in general areas, and compare with values recommended. Investigate need for local lighting units at workplaces. Determine whether layout of system and switching arrangements give sufficient flexibility to permit burning only such lamps as are needed during the daytime or at night. Consider the use of phototube control of all or part of the lighting system, to maintain constant level of illumination and prevent waste of energy. Note whether there is lack of uniformity of illumination in any area, shadows, marked contrasts between intensity of light on upper walls and ceilings and the intensity below lighting units, direct glare from lighting units, or reflected glare from any surfaces. If a large number of comparatively small lamps are used, consider the advisability of replacing them with a smaller number of larger lamps, in order to increase efficiency. Study lighting requirements to determine whether they can best be served by general, localized general, or local lighting, or some combination of these, to determine whether any change in present system is advisable. Check service conditions as to the presence of explosive gases or vapors, steam, corrosive fumes, and so on, to determine whether the proper types of reflecting equipment are being used.

Testing an oxwelded pipe joint with the familiar stethoscope. A true ringing sound near the weld when it is struck lightly with a hammer indicates a good weld at that point

How to Tell a Good Gas Weld



Simple tests can be used for checking the quality of oxyacetylene welding both in routine production and in maintenance work

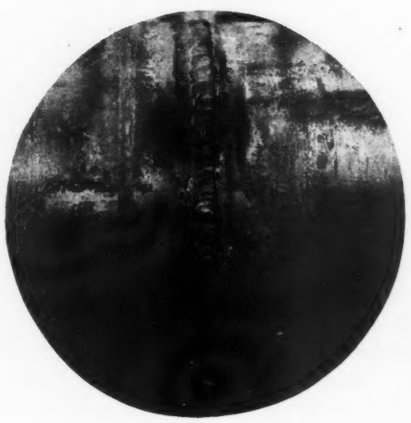
T. W. Greene

Development Section, Engineering Department
The Linde Air Products Company, New York

EVEN knowing that oxyacetylene welds have been made by operators properly trained and qualified to do the work, many supervisors like to have some basis for judging day-to-day quality of the welding without destroying the part welded. There are a good many ways of doing this, and in the hands of an experienced man, several of them are equivalent in value to some of the so-called "destructive" tests.

Seams in sheet steel are often tested by heating the sheet to a red color along one side of the weld with the welding blowpipe flame. When the weld has been properly made, the heat will transfer evenly across the joint as the flame is moved along. Where there has been lack of fusion, however, the heat will not be conducted through the weld as quickly, and a darker spot will show up on the other side.

Further examination of weld areas suspected of being defective can be made by melting weld metal away from the weld with the oxyacetylene flame. Lack of fusion at any point is made known by the appearance of oxides brighter in color than the rest of the molten weld metal. The faulty sections are then rewelded with the flame, adding welding rod if necessary.



Oxyacetylene weld in 10-in. pipe. Note even width and reinforcement characteristic of satisfactory welds

It would of course be impracticable to test every weld in this manner, but if done occasionally it will serve to check up on the quality of the work.

The method of observing heat transfer is not practicable for heavier sections, $\frac{1}{8}$ inch in thickness and above, but the melt-out test can be used with good results. It is merely a method of searching through the weld metal for possible oxides and blowholes, which, depending on size and extent, are naturally points of weakness since they represent a break in the continuity of the weld and base metal.

The inner side of the joint is the point which gives inexperienced welders the most trouble. If, therefore, the melting is started from the inside in making the test, any of the more prominent defects will be located first and their extent estimated. This is a valuable test for the student welder to make since it lets him know very quickly any trouble he may be having with welding the bottom of the joint.

For very heavy welds, the cutting blowpipe will disclose oxides and blowholes even more quickly than the welding blowpipe. The surface of the weld is cut away very gradually until the base metal is reached. The lighter color of any oxides present is readily discernible as the cutting progresses.

Just as the conduction of heat through a weld is used

to determine quality, so can the transmission of sound serve the same purpose. A stethoscope—an instrument used by physicians and readily available— is held on the base metal a short distance from the weld so that the sound the weld gives off when tapped with a hammer can be heard easily. Good weld metal will give a clear, ringing sound, whereas faulty sections give a dull, flat sound. Experience in applying this test can be gained by making both good and poor welds, and testing to distinguish the different sounds.

A pressure test is another excellent means for evaluating weld quality in products that are to contain liquids or gases. The test is generally made with the particular liquid or gas which will be held in service, and at two or more times the working pressure if possible—but not so high that the metal will be overstrained or deformed.

A more searching test can be made occasionally if a liquid or gas of great penetrating power is employed. Kerosene, for example, is much more apt to seep through a faulty weld than is water; hydrogen is much more likely to come through than air. Leaks along the edge of a weld are much more indicative of poor welding than an occasional pinhole leak in the center.

Appearance May Deceive

The most common way to judge a weld is by its surface appearance. The natural assumption is that a smooth, even-appearing weld could only have been made by an experienced welder and that the chances are greatly in favor of the remainder being of good quality. This is true to quite an extent, particularly so if places which are more difficult to weld look as good as the rest of the joint. Too much attention, however, can be paid to surface appearance and not enough to fusion at the bottom of the joint. The requirements of a satisfactory weld surface are that there be sufficient reinforcement — no low spots—and that at the edges the weld metal merge evenly into the base metal without any overlapping. If a ripple weld has been made, the ripple should be fairly even and regularly spaced, but the weld need not look as if it had been molded.

Visual examination is probably the best means for judging the quality of welds without delay. A qualified operator or instructor can quickly size up another welder's work

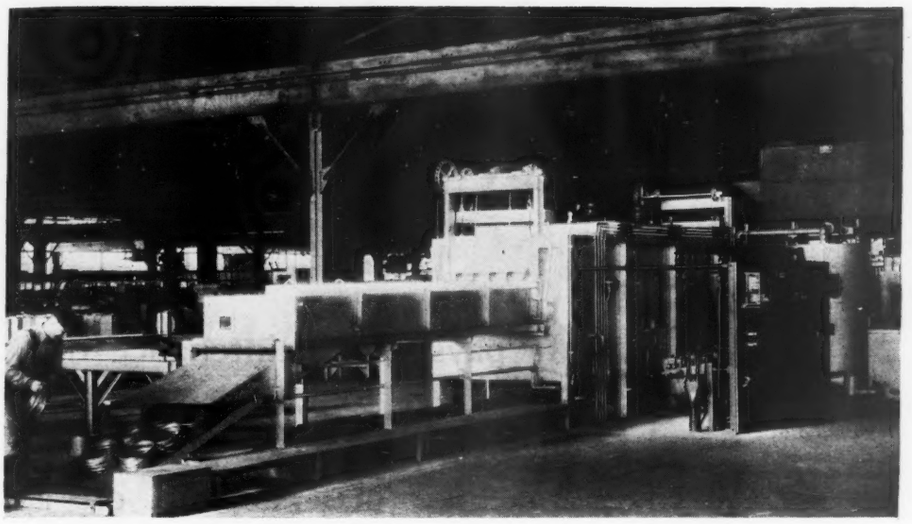
Probably the best of the non-destructive tests, and the one most easily applied, is the visual inspection test—actually observing the welding as it is being done. The only requirement is that the observer be fairly experienced, either himself a welder, or one who has observed considerable welding and seen many welds tested by various laboratory methods. He should of course be able to tell whether the welder is following the proper practices with regard to size of flame, welding rod, and technique; whether the welding puddle is being overheated; whether insufficient heat for thorough fusion is being used; and especially whether the welding puddle is fusing with the base metal in the proper manner at all points, especially at the bottom.

When welding steel plate or pipe of sufficient thickness so that the joint is beveled—usually 3/16 inch or more—a properly trained welder will pay particular attention to the manner of welding the bottom of the vee. Just as the bottom faces of the vee become molten as the welding progresses, he will bridge them together either by permitting molten metal from the puddle to flow ahead or by melting metal from the end of the rod. If he does this carefully, practically no metal will protrude inside the joint, yet a bend test made on a section would show that complete fusion had been secured through to the bottom of the weld.

It is always a good plan to check up on one's judgment in making these non-destructive tests by making destructive tests whenever a good occasion presents itself. The easiest to apply is the fracture examination test. A strip is cut from across the weld and this is fractured through the center of the weld metal by hammering in a vise or by nicking the weld and fracturing it by a sudden blow, much the same as when breaking bar stock. Defects in the weld will usually be disclosed along the fractured surfaces and are readily evaluated. An even more careful check can be made with a tensile testing machine, by which the actual tensile strength of the joint can be determined. Bend tests are also useful where it is desired to learn the ductility of the weld metal.

Now as to Bronze

Most of the discussion thus far applies to fusion welding, especially the welding of iron and steel. The quality of a bronze weld is judged best by the visual inspection test if it is not practical to use any of the various destructive tests as frequently as desired. The principal points to be looked for in bronze welding concern heat control and tinning. If too much heat is used, the weld metal tends to boil and form into drops which roll off as fast as the rod is added; if the metal is too cool, tinning does not occur properly or with sufficient rapidity and the welding is retarded. With proper tinning, the flow of bronze just ahead of the welding puddle will be free and natural like water spreading over a clean, damp surface and will be unlike the appearance of water spreading on a greasy surface. The edges of the molten bronze will not round out like a drop of mercury, but will tend to spread out and flow freely over the heated surfaces of the vee. Proper tinning is vital since it provides a strong bond between base and bronze-weld metal.



Anneals But Doesn't Dull

Controlled-atmosphere electric furnace bright-anneals copper tubing, does entirely away with time-consuming pickling and washing

IN THE manufacture of copper tubing, a cylinder of copper is drawn with a graduated series of dies and plugs, reducing both the outside diameter and the wall gage down to specifications.

Drawing operations harden the metal. At several stages, consequently, ductility is found to be so decreased that the problems of further drawing operations multiply to a point where it becomes advantageous to anneal the stock to soften the metal. However, in any annealing furnace which does not have atmospheric control, the copper tubing emerges softened from such heat-treating, but likewise possessing a dull oxidized finish which is considered undesirable. A pickling operation, followed by washing to remove the acid, has always been needed to restore the bright finish.

It has therefore been found economically advantageous at the Cleveland plant of The Chase Brass & Copper Company to substitute a controlled-atmosphere electric furnace for the pickling and cleaning operations identified with ordinary annealing methods.

A motor-driven conveyor carries the material through the heating and cooling furnace sections. A variable speed drive regulates the rate of passage for different types of tubing and rods and for the degree of anneal desired. Copper tubing placed on the conveyor at the lower end of the charging hood comes out at the lower end of the discharging hood bright-annealed and ready for inspection, sealing, packing, and shipment.

To Prevent Discoloration

The artificial atmosphere, maintained within both the heating and cooling chambers of this furnace is obtained by partially cracking natural gas, involving the mixing of illuminating gas in a closed chamber containing a controlled supply of air. The combustion of cracking is started by means of heat from electric elements drawing 33 kilowatts at the outset. The gas is introduced into the furnace through pipes cooled from a refrigerating unit sufficiently to remove by condensation any lingering water vapor in the gas, and is kept in a state of constant agitation by means of ten fans, three located at intervals in the top of the heating chamber and seven equally spaced the length of the cooling chamber top. Each fan is driven by a 1-hp., 1,120-r.p.m. motor.

The heating compartment has heavily insulated walls in which are mounted the electric heating elements which provide two heat zones with a range of 1,000 to 1,200 degrees Fahrenheit. The cooling chamber lowers the temperature of the material passing from the high heat zone by circulating water between its double walls. Discoloration is thus further prevented as the metal comes out into contact with the atmosphere and cools down to room temperature.

The copper tubing, to minimize inner surface corrosive action, is, prior to entering the annealing furnace, filled with the same gas that is used in the furnace interior. Depending upon the specifications of the manufacturer ordering it, one or both ends of the tubing are sealed as each coil is taken from the furnace.

How to Arrange Leads in Wire-Wound

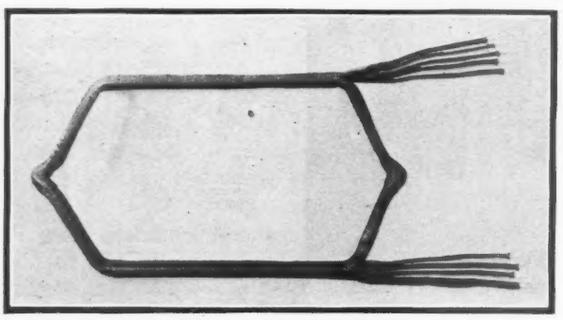


Figure 1. Diamond-pulled coil consisting of five single coils placed depthwise. The turns are placed widthwise. Leads come out at the sides

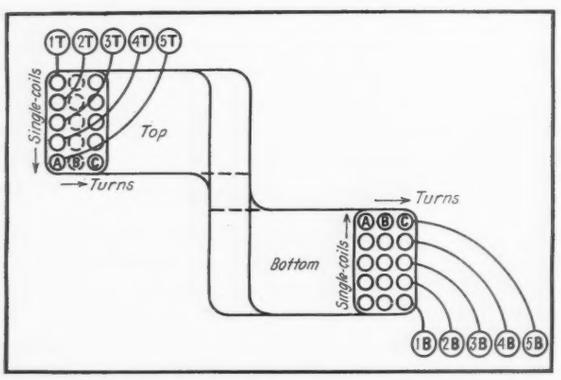


Figure 2. Pulled-type coil with the single coils built up depthwise and the turns widthwise. Note how the single coils are built up towards the center of the coil, as indicated by the arrows

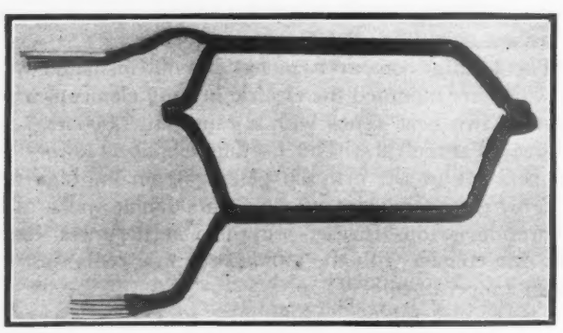


Figure 3. Diamond double-loop coil comprising five single coils placed widthwise, with the turns depthwise. Leads come out on the top and bottom

It pays the maintenance department to know. Continued operation of a $10,000 machine may depend on a $50 set of coils

An article in the April issue discussed the arrangement of leads and single coils of diamond-type, wire-wound coils. In this article diamond-type pulled, double-loop, and drop-type coils will be considered.

THE diamond-shaped pulled coil shown in Figure 1 has five single coils per coil, the single coils being built up depthwise and the turns widthwise, as indicated by the numbers and letters in Figure 2. The top leads are bent up and fanned out so as to be one wire thick and five wide, as shown by the notation *1T, 2T*, and so on, lead *5T* being twisted up to the right. The bottom leads are also fanned out, but in this case lead *5B* is bent down and towards the right. Hence the twisting of the leads is similar to that shown in Figures 3 and 4 in the preceding article. The lead arrangement of this type of coil is the same for either a mold-wound or a pulled coil.

When connecting to the commutator the leads of the coil shown in Figures 1 and 2, it is necessary to make two layers of top leads and two layers of bottom leads. This is done by putting three leads of one coil first in the bottom layer, and then the two remaining leads from the same coil in the upper or second layer. Then, on the next adjacent coil wound in, the process is reversed—that is, two leads are put in the bottom layer and three in the upper. In this way the ten leads from two adjacent coils are placed in two layers, two deep and five wide. The arrangement of three down, two up, and then two down and three up is alternated throughout the winding.

The bottom leads of each coil are connected in two layers as the coils are installed, whereas in connecting the top leads one layer is put down at a time; for example, two from one coil, three from the next, then two and repeat, a bar being skipped between each lead. It will be found simpler when connecting the bottom leads to start with three down in the first layer and on each second coil leave the last lead of the second layer un-

Armature Coils

A. C. Roe

connected until the leads in the bottom layer from the next coil have been placed. This permits the wire referred to to lie in its proper groove.

A double-loop, diamond-type coil as shown in Figure 3 has the single coils arranged widthwise and the turns depthwise. The main feature of this coil, which leads to its wide use with ribbon wire, is the method of bringing the top lead off the top half of the coil, and the bottom lead from the bottom of the bottom half of the coil, as shown in Figures 3 and 4. It is done by making a double loop at the rear diamond point of the coil. With this type of coil the leads are in the proper position and sequence for connecting directly to the commutator necks, since they are shaped and bent while the coil is being made, thus reducing the winder's work to a minimum.

Figure 4 shows the position of the leads and turns of the double-loop coil of Figure 3. Note that on the bottom half of the coil the turns progress depthwise, as shown by the letters *A, B,* and *C,* whereas on the top half-turn *A* is on top, forming the top or starting lead. Next is turn *C,* and then *B*. Therefore, the double loop (Figure 3) at the rear diamond interchanges the position of the top lead from the bottom of the top half of the coil, indicated by the dotted lines at *D* in Figure 4, to the top of the top half of the coil, as shown by the letters *1T, 2T,* and so on.

The double-loop coil, therefore, eliminates lead-bending while winding an armature and permits proper insulation of the bend or crossover in the coil itself.

The drop-type coil is of the diamond-shaped-end variety, but instead of the customary loop at each end of the coil a flat, S-shaped bend drops the turns from the upper to the lower layer of coil ends without changing the arrangement of the single coils. This type of coil, shown in Figure 5, has characteristics of its own that warrant its being classified as a separate type.

Single coils of a drop-type coil are built up depthwise in both halves of the coil, with the turns widthwise. The bottom leads are always the starting leads when winding the coil; hence the top leads are the finishing leads. The mold is arranged so that the bottom or starting leads are fanned out and brought off the bottom of the coil, one wire deep by as many wires wide as there are single coils. This feature can be seen in Figure 5, which also shows how the turns and single coils are shaped around the drop diamond points.

Study of Figures 5 and 6 will indicate how the leads, turns, and single coils are distributed in a drop-type coil:

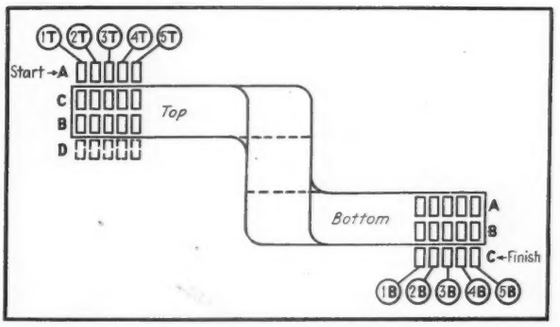


Figure 4. Sectional view of double-loop coil shown in Figure 3. The dotted lines at *D* indicate where the top leads would be in an ordinary diamond coil

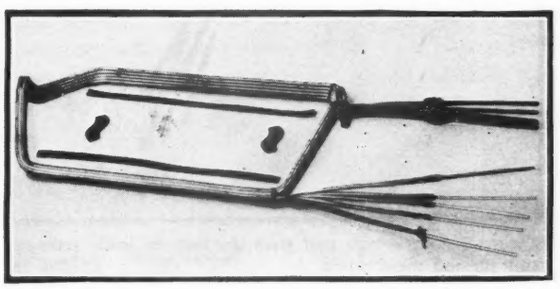


Figure 5. Drop-type, mold-wound coil with single coils placed depthwise, turns widthwise. The leads come out at the sides

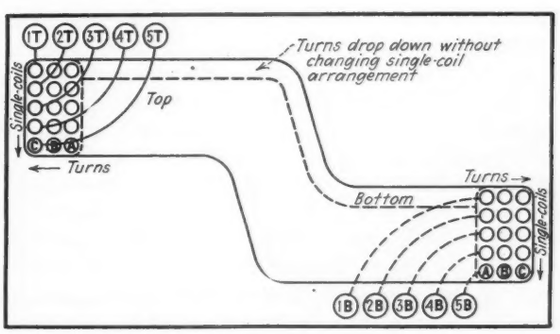


Figure 6. How the single coils, leads, and turns are arranged in a drop-type coil consisting of five single coils of three turns each. See Figure 5 also. Note the dotted line turn dropping from top to bottom; hence the term "drop-type"

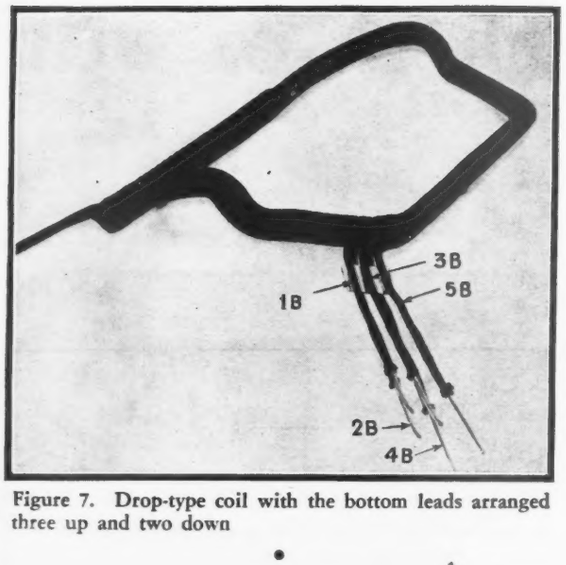


Figure 7. Drop-type coil with the bottom leads arranged three up and two down

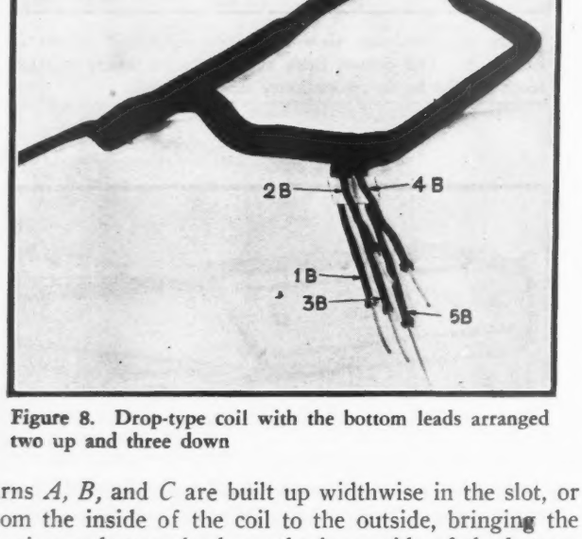


Figure 8. Drop-type coil with the bottom leads arranged two up and three down

turns *A, B,* and *C* are built up widthwise in the slot, or from the inside of the coil to the outside, bringing the starting or bottom leads on the inner side of the bottom half of the coil and the finishing or top leads on the outer side of the top half of the coil. The position of the top and bottom leads from each single coil does not change their planes—that is, *1T* and *1B* are on the upper part of the top and bottom halves of the coil. To bring out the single coil leads in the proper sequence for connecting to the commutator it is necessary to fan the bottom leads on the inside of the front diamond end of the coil and bring them out from under the bottom edge, as shown in Figure 6. The bottom leads are therefore twisted to the left and down. The top leads are fanned and bent up against the outer surface of the front top diamond end, being twisted to the right and up and brought out flush with the top edge, side by side.

Leads of drop-type coils are generally tied to the coil in the correct position with tape, which reduces the lead forming by the winder to separating the top and bottom leads into two layers, when connecting them to the commutator necks. Figures 7 and 8 show the general appearance and shape of the drop-type coil; also, how the bottom leads are re-formed to permit laying in two layers. In Figure 7 leads *1B, 3B,* and *5B* are separated and raised up above *2B* and *4B*. A small piece of insulating material is put close to the coil between the two layers of leads thus pressed together so that the group is three wires wide on the top and two wide in the lower layer. The leads are again fanned out into a single layer directly back of the commutator necks.

Figure 8 shows how the alternate coils have the bottom leads formed by the winder into two layers, leads *2B* and *4B* being placed in the upper layer, and *1B, 3B,* and *5B* in the lower layer. Therefore the top layer is two leads wide and the bottom three wide. The armature is wound by placing the leads three down and two up, then two down and three up, and repeat.

The small piece of insulation referred to above is important since it protects the leads at the point where they are changed from one to two layers and considerable mechanical pressure is exerted. If the insulation is not used, or is incorrectly applied, short circuits may occur.

Top leads of drop-type coils are also put down in two layers—first two and then three and so on—but in this case the procedure is to put down one layer first, skipping a bar between each successive lead. The first layer of leads is covered with insulating material; then the second layer is put down, thus passing around the armature twice when connecting the top leads.

Comparing Pulled and Drop-Type Coils

If Figure 2 is compared with Figure 6, a difference will be noted in the arrangement of leads and single coils. Figure 2 shows a pulled coil with the leads on the side, similar to the mold-wound, drop-type coil. In Figure 6 the turns build up from left to right in the bottom half and from right to left in the top half, or away from the center. In Figure 2 the turns build up from left to right in both the top and bottom coil halves. On checking the single coil arrangement it will be seen that in Figure 6 the drop-type coil has the single coils progressing downwards from the top of each coil half, whereas in Figure 2 the single coils build down in the top half and up in the bottom half of the same coil.

Again, comparing Figures 1 and 2 with Figures 5 and 6, it will be noticed that with the pulled coil of the first two figures both the top and bottom leads are bent towards the right, while in the drop-type coil of Figures 5 and 6 the top leads are bent towards the right and the bottom leads towards the left, so that both sets of leads go towards the center of the coil. Also, in Figures 1 and 2 the bottom leads are on the outside edge of the bottom half of the coil, but in Figures 5 and 6 the bottom leads are on the inside edge of the bottom half of the coil. The top leads in both cases are brought off from the outside edge of the top halves.

There is, therefore, considerable difference in this case between a pulled coil and a mold-wound coil. Hence it is important to know the details of coil construction for ease in locating and laying the leads.

▶ **A concluding article will discuss short-type coils and give directions for testing the coils described**

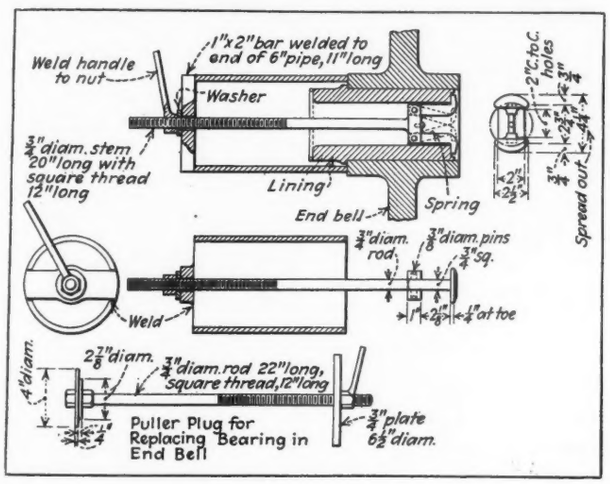
MAINTENANCE SHORTS

Puller for Solid Bearing Linings

WM. B. CONE, Chief Electrician
The Shevlin-Hixon Company, Bend, Ore.

Removing and replacing solid bearing linings in motors can be facilitated greatly by the puller shown in the sketch, which is designed to handle 3-in. linings.

To remove a lining the puller rod and hooks are shoved through the lining, and the spring snaps the hooks into position. A bushing cut from a piece of pipe is then placed in position over the endbell and the puller nut is tightened, drawing out the lining. In replacing an exceptionally tight lining a circular plug may be used in place of the hooks, to prevent crushing of the babbitt. It is, of course, impossible to use this plug in removing the lining.


Weld handle to nut
1"x2" bar welded to end of 6" pipe, 11" long
Washer
¾" diam. stem 20" long with square thread 12" long
Lining
End bell
Spring
2" C. to C. holes
Spread out
¾" diam. rod
⅞" diam. pins
¾" sq.
Weld
1" 2⅛" ¼" at toe
4" diam.
2 7/16" diam.
¾" diam. rod 22" long, square thread, 12" long
Puller Plug for Replacing Bearing in End Bell
¾" plate 6½" diam.

The hooks are made from ¾-in. square key stock, with the ends flattened to conform to the proper circle and give as much contact as possible without sacrificing strength. The ends should not extend over the outside of the lining.

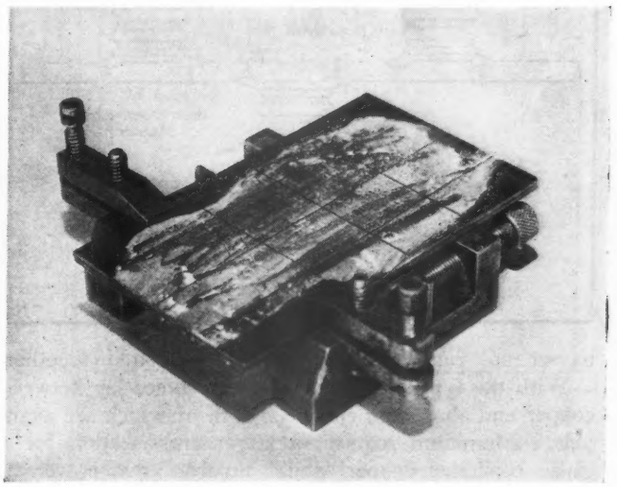
One set of hooks will handle several sizes of linings. With a ¾-in. puller rod having square cut threads, and a pulling nut 1½ in. thick, the most obstinate lining can be made to yield.

•

For Drilling Flat Plates

H. MOORE, Hamilton, Ontario, Canada

Whenever I have a couple of plates to drill alike I lay one off and clamp both together for drilling. This, of course, is the usual method in all shops, but where my set-up differs is in the clamping. Most machinists use a clamp at each side with parallels to raise the work clear of the clamps. This is awkward because the parallels are likely to get beneath the drill, and sliding



the work around often knocks them over. The illustration shows, I think, the superiority of using clamps entirely for the work.

It will be seen that two small clamps are held in two vise clamps with the bottom jaws of the former level with the top of the jaws of the latter. The whole thing makes a solid set-up that can be slid around without fear of anything falling over.

•

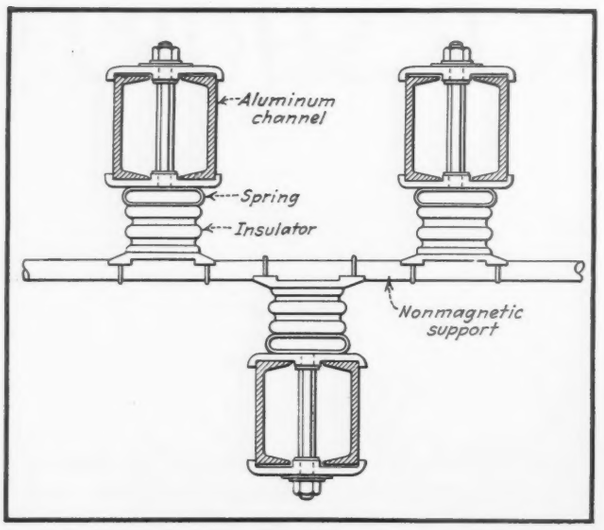
Aluminum Channels Form Efficient Busbar

SOURCE, Clinton Corn Syrup Refining Company
Clinton, Iowa

Recently a Middle-Western refining plant had to increase its generating station capacity from 6,160 amp. to 9,010 amp. at 440 volts. The main generator buses, two sets of copper bars ¼ x 4 in., were not adequate for the increased load. Calculations indicated that adding new bars to the buses as installed would increase the heating of the inner bars and add little to the effective capacity.

To meet this situation recourse was had to a type of channel bus. Two copper or aluminum channels of standard structural shape are bolted together, with separators which hold the channel sections in approximately the form of a hollow square with a space between the top and bottom edges of the channels.

In losses due to skin effect the hollow square form of the composite conductor approximates the efficiency of the hollow, tubular type. At the same time a larger effective radiating surface for dissipating heat is presented by the hollow square than by the conventional, parallel-bar conductors. The openings between the channels help to ventilate and cool the interior of the bus. Structurally, the paired channels are rigid and easy



to set up, can be either welded or bolted together.

With the type of bus selected the choice lay between copper and aluminum channels, both of which are available. Aluminum requires a larger cross-section for a given capacity; copper would involve greater weight. This installation required about 40-ft. lengths. Since copper was not available in this length without splices, and because of the lighter weight of aluminum, the latter was chosen. A bus made of three pairs of 8-in. aluminum channels was used. The replaced flat-bar copper buses were used to increase the capacity of the distributing bus system.

Six-inch aluminum channels, mounted in pairs to form a triangular three-phase circuit, also solved the problem of making a neat and rigid connection from the new 3,750-amp. generator to the switchboard. Flat, oval springs were placed between the bus clamps and the supporting insulators to take up any mechanical surges that might be set up by heavy short circuits.

•

Portable Meter Finds Off-Again, On-Again Ground

R. H. Rogers, Industrial Engineering Department
General Electric Company, Schenectady, N. Y.

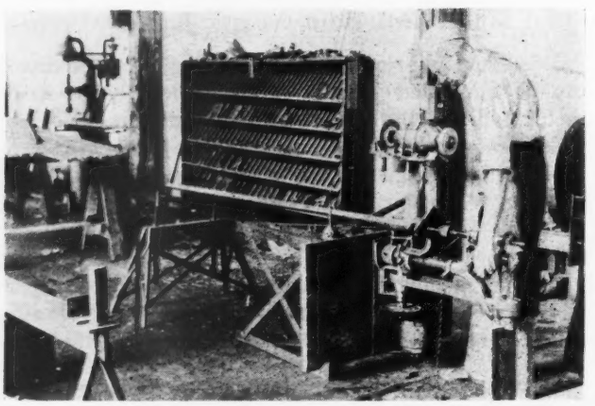
Oftentimes careful inspection will disclose the cause of trouble with equipment, but there are occasions when it is difficult or impossible to locate it in this way.

One such case involved a hoist motor that would operate satisfactorily for a 15-min. period and then perform erratically. After a shutdown for inspection and the application of various remedies it would run all right for another period, only to go bad again. Portable instruments showed a ground just at the instant that trouble started. It was traced, also by means of portable instruments, to the conduit box on the motor where a long, vertical run of cable joined the motor leads. Expansion of one cable shoved it hard up against the box, and inadequate taping caused it to ground. When the cable cooled off it contracted sufficiently to clear the ground, but when heated by 15 min. of operation the ground would come on again.

Horizontal Work with Vertical Drill

Joseph C. Coyle, Los Angeles, Calif.

In filling an order for ornamental steel gates a Los Angeles firm had to drill a number of long square steel bars in the ends. The work was done by turning a small vertical drill on its side. The top of the machine



was supported by a block of wood, the bottom by the table (with welded frame and wood top) on which it was mounted. One end of a bar to be drilled was placed on a small shop trestle and the other in a small vise which was attached to the metal base of the drill with a large U-clamp.

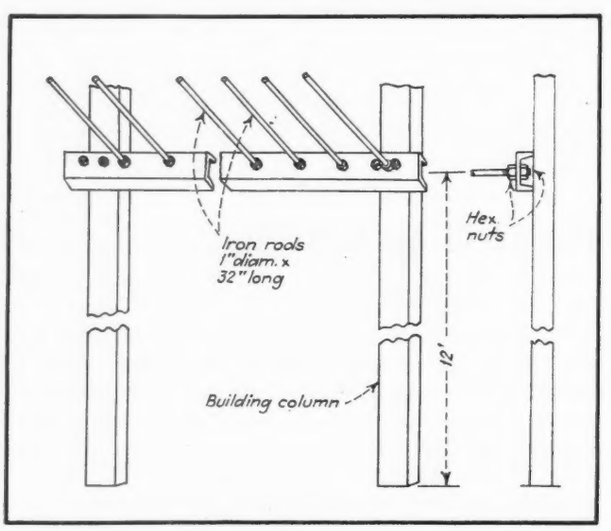
•

Ladder Rack Conserves Space

Chas. A. Peterson, South Bend, Ind.

Every maintenance department must have available a number of ladders for the electricians, painters, pipe fitters, and belt repairmen. Usually these ladders are piled up where they are more or less in the way, and when one is needed it is necessary to move three or four others in order to get at the right one.

The ladder rack shown in the sketch has been found



to be very handy. It keeps the ladders off the floor and each one is available without disturbing the others. Also, it reduces the chance of rungs being broken by heavy objects falling on them, which often had occurred in the past.

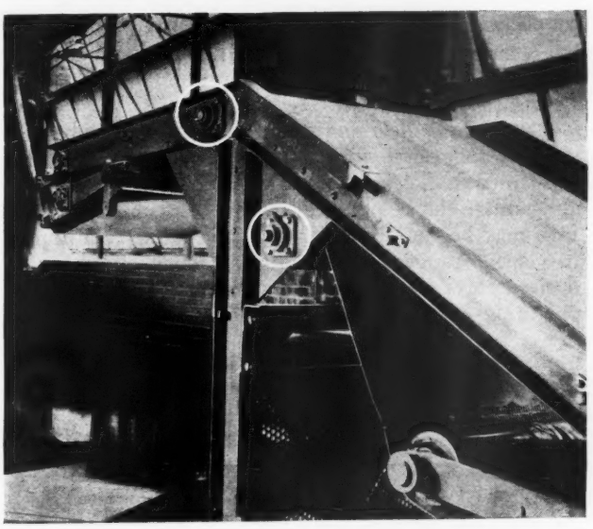
The rack consists of a number of 1-inch iron rods threaded at one end and spaced 5 inches apart on a piece of channel iron which in turn is fastened to the building columns in the maintenance department.

•

Bolted-On Ball Bearings Simplify Installation

SOURCE, The Fafnir Bearing Company
New Britain, Conn.

Work of putting ball bearings on a conveyor at the Goodrich Rubber Company's Akron plant was reduced considerably by the use of flange cartridge units. These units were bolted directly to the structural supports, the shaft extending through the web of the channel. If



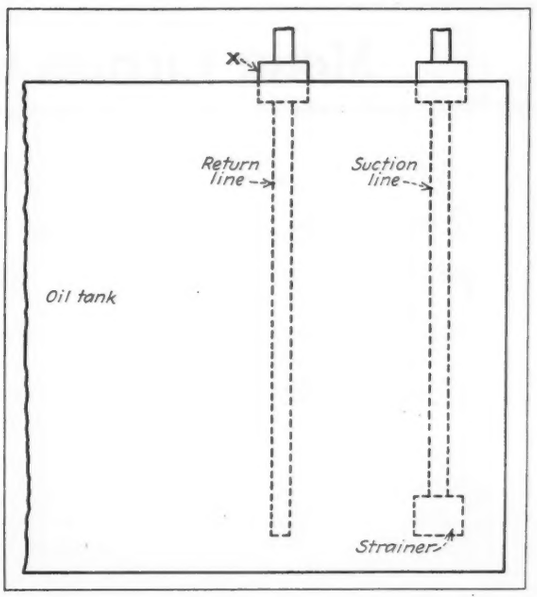
conventional pillow blocks had been used it would have been necessary in some places to build up shelves or brackets for mounting them. The self-aligning feature of the bearings makes it unnecessary to align them with great accuracy.

•

Reversing Lines to Oil Tank Prevents Clogging

WILLIAM ANDERSON, Brooklyn, N. Y.

In an industrial plant that burns light oil for process work it was found one morning that no oil was being delivered by the pump. After checking the pump it was concluded that the trouble was in the suction line or strainer. After digging down to the tank, which was buried under the concrete floor and had no manhole, the suction leg was removed and a piece of waste rag was found to be wrapped around the strainer.



In order to prevent trouble from occurring again, the connection shown in the sketch was installed. The suction line from the oil pump is fitted with a strainer, but no foot valve, although one had been used in the original installation. The oil return line originally ended at point *X* but under the new arrangement it was extended nearly to the bottom of the tank.

If the strainer becomes clogged now, the return line may be used at a suction line by changing a few nipples at the burner, and the suction line used as a return line. The reversal of the pressure on the strainer will tend to clear it of anything that is clogging it.

•

Handy Storage for Small Taps and Dies

JOHN E. HYLER, Peoria, Ill.

More time is required in the average maintenance department to hunt up the proper taps, dies, nuts, bolts, and drills than it takes to do an every-day job of tapping and threading.

The method that I use for storing such small tools has been a big help in this respect. For very small taps and dies I use a glass mayonnaise jar fitted with its regular cover. For larger tools fruit jars of varying sizes are used with their covers. In each jar is stored the die for cutting a male thread of given size, the corresponding tap for cutting the female thread to match, an assortment of standard bolts and nuts with the same size of thread, and a drill, preferably of high-speed steel, of the correct size for the tap. These jars are arranged, consecutively as to thread sizes, on a shelf.

For lubricating taps and dies, castor oil is much better than any ordinary lubricant—superior even to lard oil. Very little of it is needed and a small bottle that will fit readily into one of the storage jars will hold enough to last for a considerable length of time on maintenance work.

Data Sheet

Motor Circuits for Adjustable Speeds

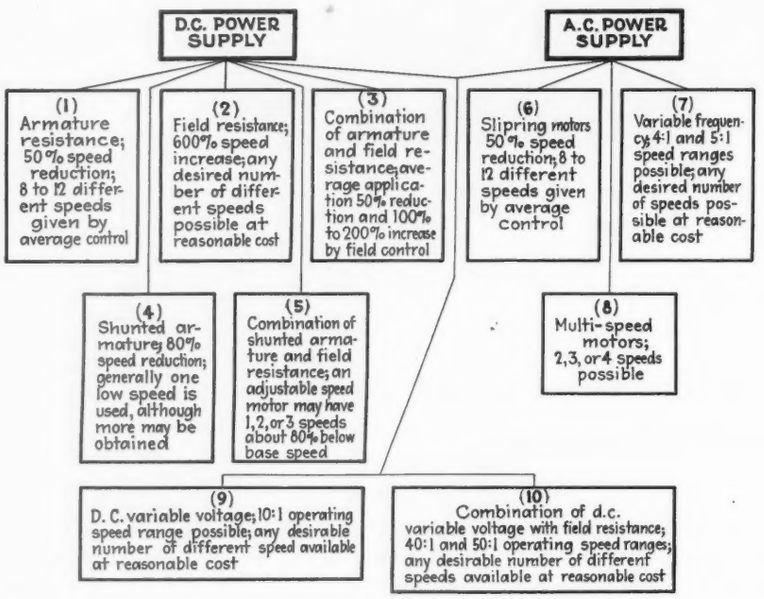
The charts and description on this and the two following pages provide a ready reference that will simplify the task of choosing the most economical method of obtaining by electrical means variable speeds of the desired range and characteristics

SEVERAL different means by which variable speed power may be obtained from either d.c. or a.c. supply are noted on the accompanying chart. If d.c. is available, variable speed with various characteristics can easily be obtained.

Armature resistance speed control (Diagram *A*) has the characteristics noted in group *1* of the chart. The control is so built that several steps of resistance can be connected into the armature circuit to give corresponding speed steps. Horsepower output varies directly with the speed. Speed regulation (relation of no-load speed to full-load speed) is poor and efficiency is low because of the power lost in the armature resistance. However, this system of speed control is economical for certain applications where horsepower output decreases rapidly with speed. Fans are in this class, the horsepower required varying as the cube of the speed. A fan load, moreover, is steady and there are no regulation problems involved.

Field resistance control is the most common scheme used for obtaining variable speed with d.c. motors. Its salient characteristics are given in group *2* of the chart, and connections are shown schematically in diagram *B*. Speed increases from a few r.p.m. to 600 per cent rated speed may be obtained. The available horsepower output increases slightly with the speed because of increased ventilation. Speed regulation and efficiency are good. Practically any speed gradation up to the limit mentioned can be obtained without great cost. The resistance in the field may have as many as 200 points, although this is not so common as 20 to 60 points. If sufficient steps are not obtained with a single rheostat, a second interpolating or vernier rheostat may be connected in series with the main rheostat. Thus the speed of a motor may be changed by as little as one revolution a minute.

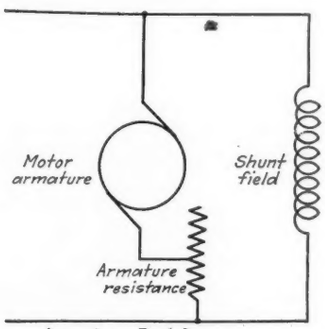
Combination field and armature control may be used as suggested in group *3*, of the chart, and illustrated in diagram *C*. Actually a 12-to-1 operating range can be obtained by this control. Some fans may be operating most of the time over a 2-to-1 speed range, but sometimes a lower speed is desired for a short time. In such cases the 2-to-1 operating speed is obtained by field control with


D.C. POWER SUPPLY
A.C. POWER SUPPLY
(1) Armature resistance; 50% speed reduction; 8 to 12 different speeds given by average control
(2) Field resistance; 600% speed increase; any desired number of different speeds possible at reasonable cost
(3) Combination of armature and field resistance; average application 50% reduction and 100% to 200% increase by field control
(6) Slipring motors 50% speed reduction; 8 to 12 different speeds given by average control
(7) Variable frequency; 4:1 and 5:1 speed ranges possible; any desired number of speeds possible at reasonable cost
(4) Shunted armature; 80% speed reduction; generally one low speed is used, although more may be obtained
(5) Combination of shunted armature and field resistance; an adjustable speed motor may have 1, 2, or 3 speeds about 80% below base speed
(8) Multi-speed motors; 2, 3, or 4 speeds possible
(9) D. C. variable voltage; 10:1 operating speed range possible; any desirable number of different speed available at reasonable cost
(10) Combination of d.c. variable voltage with field resistance; 40:1 and 50:1 operating speed ranges; any desirable number of different speeds available at reasonable cost

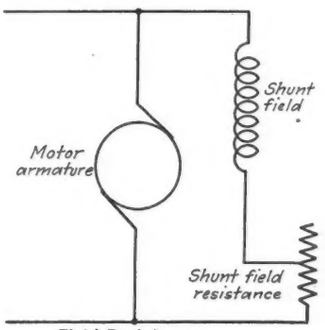
Submitted by PAUL W. ARNOLD, *Development Engineer*
The Reliance Electric and Engineering Company, Cleveland

Data Sheet

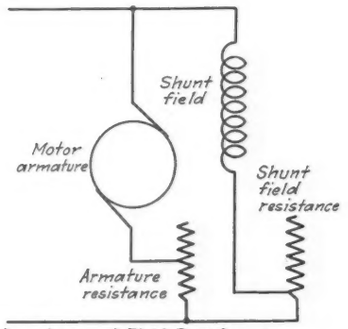
Motor Circuits for Adjustable Speeds



Armature Resistance
A



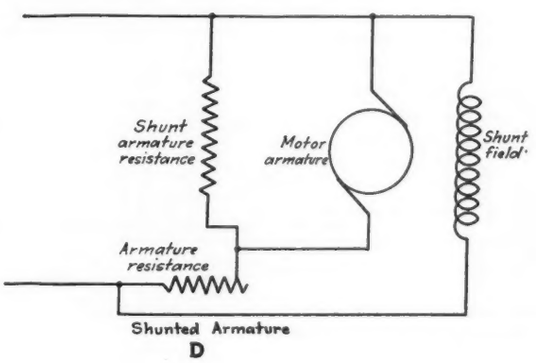
Field Resistance
B



Armature and Field Resistance
C

high efficiency, and the lower speeds by armature control. If the motor were designed to operate at the low speed by field control its first cost and physical size would necessarily be greater.

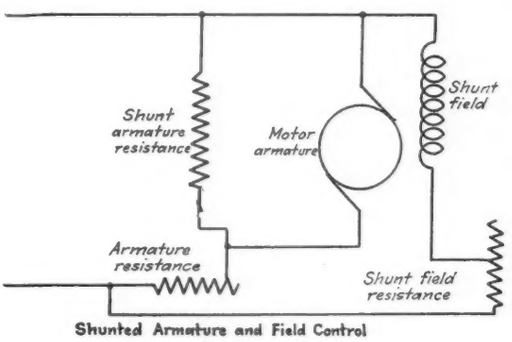
Shunted armature control is actually a variation of armature control. This can easily be seen by comparing diagrams *A* and *D*. A comparatively low resistance of high current-carrying capacity is connected across the motor armature. A second resistance is connected in series with the armature. This resistance is less than that necessary for straight armature control to obtain corresponding low speeds. The armature shunt causes a relatively high current to flow through the armature series resistance, which need not be as great to cause the same voltage to be impressed on the armature as in straight, series-resistance control. This means that when the load of the motor varies there is a smaller variation in the voltage actually impressed on the armature than with straight series resistance. Speed varies directly with armature voltage; hence with shunted armature control better speed regulation is secured, but speeds at all loads are reduced.



Shunted Armature
D

Shunted Armature and Field Control—In general a single point of shunted armature control is used in conjunction with field control (diagram *E*). For example, a motor may operate over a range of 400 to 1,600 r.p.m. and then have a shunted armature point with which 80 r.p.m. can be obtained. This method is not always applicable for continuous duty because the losses in the resistors are likely to be great.

Variable voltage is not truly a d.c. power drive and is used only occasionally when d.c. power is available. Certain variations may be included. It will be described later as an a.c. drive.



Shunted Armature and Field Control
E

To vary the speed of a.c. motors, the frequency of the power supply may be varied, the slip (drop in speed from synchronous speed) increased, pole combinations changed, or the a.c. converted to d.c. and d.c. control methods used as already described.

(Continued on the following page)

Data Sheet

Motor Circuits for Adjustable Speeds

(*Continued from the preceding page*)

If high-resistance material is used in the rotor of a squirrel-cage motor, it will run more slowly under full load than one with a low-resistance rotor. With wound-rotor construction, resistance may be inserted in the rotor circuit, making possible speed reductions of 50 per cent. The external rotor resistance can be varied in steps and several speeds obtained. Speed regulation of wound-rotor motors is very poor and for this reason they are generally used on constant loads, such as fans. Torque developed by a slipring motor is constant, so that the horsepower varies directly with the speed.

Variable frequency is used successfully to vary a.c. motor speeds through a 4-to-1 or 5-to-1 speed range. To obtain a variable frequency it is necessary to have either an alternator or a frequency changer driven at a variable speed. Obviously, such an arrangement may be expensive, and it is necessary to have d.c. power available to supply the variable speed motor driving the frequency changer. However, some very economical arrangements have been worked out for group drives. The horsepower developed by motors operating on a varying frequency is directly proportional to the speed.

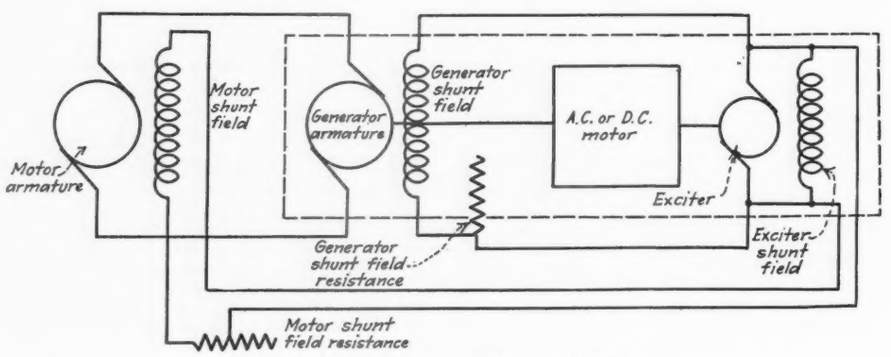
Multi-speed squirrel-cage motors are quite common. They are of two general classes—single and double winding. With the single winding, motor leads are brought out for external regrouping of the poles, making possible two "consequent" speeds. The two speeds are fixed and the low is half of the high speed.

A two-winding motor has two separate and distinct windings in the stator. Each can be grouped for practically any number of poles, thus making any two speeds possible. Furthermore, each of these windings may be arranged for external regrouping, making four speeds possible.

Speeds obtained from multi-speed motors are fixed and cannot be varied. The motors can be designed for a constant horsepower or a constant torque output. A third type, usually designed for fan drives to develop a decreasing variable torque with a rapidly decreasing horsepower, is available.

Variable voltage provides one of the best means of obtaining variable speeds, especially if wide ranges are desired. Aside from the wide speed ranges, many other desirable features are inherent in this system. Variable voltage and shunt field control are easily combined and great speed ranges are obtainable as indicated in group *10* of the chart. Diagram *F* shows the electrical set-up.

Variable d.c. voltage is usually obtained from a separate generator driven by an a.c. motor or possibly by a constant-speed d.c. motor. The shunt field current of the d.c. generator is changed by means of a field rheostat, causing the voltage of the generator to vary. This voltage is then supplied to the d.c. motor or motors driving the load. The speed of these motors varies almost directly with the voltage applied to them, and a speed range of 10 to 1 can be obtained. In order to obtain a still wider speed range, the speed of the driving motor may be increased above normal by weakening its fields; 50-to-1 or 60-to-1 speed ranges are possible. Variable-voltage systems are very successful for operating motors in tandem; but as an added precaution compensating rheostats are generally located between machines to take up variations.

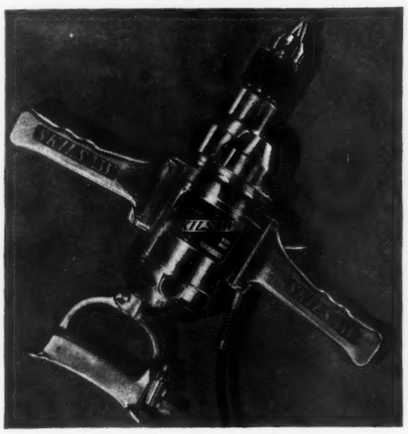


Variable Voltage and Shunt Field Control

F

· EQUIPMENT NEWS ·

Drills



Portable, electric. Ball bearing construction. Bodies of die-cast aluminum. Skilsaw, Inc., 3318 Elston Ave., Chicago.

Tractor

Small, 1-12, industrial. Maximum engine power 21 hp. Length, 96 in.; width, 15 in.; height, 52 in. over steering wheel; turning radius, 103 in. Speed range, 2½ to 10¼ m.p.h. Foot accelerator and hand control. Internal expanding-type brakes. Four-cylinder, valve-in-head International motor. Two-piece bolted frame. International Harvester Company of America, Inc., 606 South Michigan Ave., Chicago.

Welding

Bundy Tubing Co. has organized subsidiary company known as H. W. Bundy, Inc., to take over commercial, copper-hydrogen-electric welding parts production of parent company, other than tubing. Production includes both custom hydrogen welding of parts supplied by other manufacturers ready for welding and company production of finished parts. General offices of H. W. Bundy, Inc., will be in plant of Bundy Tubing Co., at 10951 Hern Ave., Detroit; manufacturing at former Bundy Tubing Co. plant, 4815 Bellevue Ave., Detroit.

Flashlight

Designed especially for heavy service and work around transmission lines, busbars, and electrical equipment. Known as "Voltpruf." Has heavy ribbed fibre case with no metal parts on outside. Heavily insulated. Manufacturer claims 16,000 volts cannot break through to internal circuit of flashlight. Available in focusing spotlight and spreadlight types. Bond Electric Corp., Jersey City, N. J.

Pyrometers

Called "Hold-Heat." Designed for use as standard equipment on equipment using heating devices. Direct-reading type. Manual cold-end correction adjustment. Heavy-gage thermocouples in place of connection leads. Hexagonal aluminum case. No. 88 has range of 60 to 800 deg. F. No. 89 has range of 60 to 1,600 deg. F. Russell Electric Co., 345 West Huron St., Chicago.

Relay

High-speed, lowering, for crane operation. Automatic. Controlled by weight of load itself. Consists of single-pole, single-throw knife switch, and spring-closed contractor, below which are a normally open circuit relay and standard two-pole control-circuit relay mounted on ebony-asbestos panel. Can be applied to any d.c. motor-operated crane equipped with series motors and dynamic lowering control. Available for any size of hoist motor, 110 to 550 volts. Harnischfeger Corp, Milwaukee, Wis.

Traps

Nason Mfg. Co., New York, is now manufacturing full line of "Detroit" steam traps, including return, vacuum, combination, and separating traps; also "Detroit" receiver.

Lock Nut

Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., has acquired from American Marsden Co., Jersey City, N. J., sole U. S. manufacturing and sales rights for Marsden locknut. A Marsden locknut division has been created at Port Chester for development of the business.

Wall Repair Material

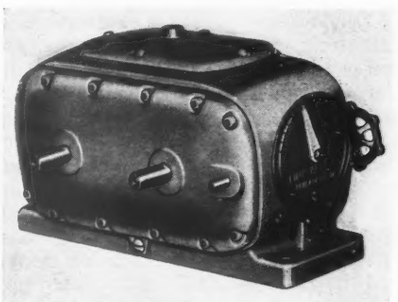
Shrink-proof. For filling cracks in building walls. Contains expanding chemical that compensates for evaporation of water, causing material to adhere to any surface. Called "Stonhard Wallseal." In powder form. Mixed with water to produce stiff paste. Applied with trowel or putty knife. Dries in 20 min. Stonhard Co., 401 N. Broad St., Philadelphia.

Bronze

For bearings. Semi-finished outside and inside. Called "Magnolia Bearing Bronze Bar Stock." Furnished in lengths of 12, 13, and 14 in. and sizes from ½ in. solid up to 5 in. outside diameter; cored up to 2½ in. inside diameter. Conforms to S.A.E. specification No. 64. Claimed free from zinc. Magnolia Metal Co., Elizabeth, N. J.

Transmission

Variable-speed. Self-adjusting, positive. For fractional horsepower duty. Known as V. R. D. (Variable Roller Drive). Capable of ½-hp. output at maximum speed. Maximum ratio of speed variation, 10 to 1. Uses chain for positive transmission of power. Speed indicator permits check-up on operating speed settings. Spring pressure applied to two disks of one wheel maintains tension and compensates for chain wear.



Furnished with horizontal or vertical box; with or without reduction gearing; can also be supplied motorized, with motor forming integral part of unit. Link-Belt Co., 910 S. Michigan Ave., Chicago.

Electrode

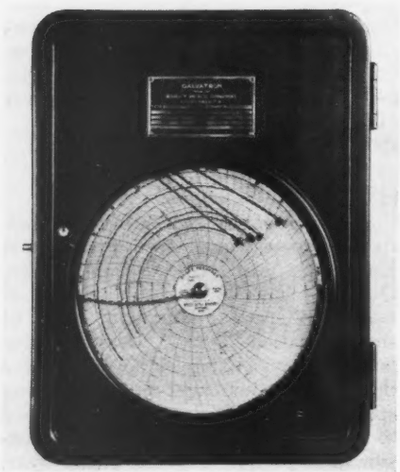
Arc-welding. Called "Shield-Arc Eighty-Five." Claimed to give welds with tensile strengths of 85,000 to 100,000 lb. per sq.in. Designed for use on high tensile steels. Ductility from 15 to 20 per cent elongation in 2 in. Suitable for flat, vertical, and overhead welding. Available in 5/32- and 3/16-in. sizes. The Lincoln Electric Co., Cleveland.

Recording Instruments

For cost and payroll. Two models. Electric cost recorder has all-steel case with Baketex finish and chromium-plated trimming. Arranged to fit any cost system. Will accommodate time cards, job tickets, or slips of any length

or width. Prints day of week or date of month in different color, to facilitate computing of elapsed time. Also electric payroll recorder in similar case and finish. Fully automatic. Driven by Telechron electric movement. Plugs into a.c. light socket. Simplex Time Recorder Co., Gardner, Mass.

Potentiometer Pyrometer



Employs galvanometer-electronic relay circuit to operate slide wire resistances and recording pens. Called "Galvatron." One Galvatron may include as many as four potentiometer circuits, contact making galvanometer being automatically switched from one circuit to next by relays actuated from contacts made by synchronous-motor-driven time device. One synchronous motor drives timing contacts for relay, galvanometer contacting mechanism, recording chart, and automatic standardizing relay contacts. Mechanism consists of galvanometer of short period arranged to make contacts of duration proportional to deflection of galvanometer needle from neutral. Automatic standardization every four hours. Visible indicator gives dry cell condition. Continuous record or individual records on circular charts. Bailey Meter Co., Cleveland.

Relay

Photoelectric, for outdoor use. Inclosed in cast-aluminum case. Can be fitted with tubular visors to protect lenses in front of either cell or lamp. Operates on standard 110-volt power lines. G-M Laboratories, Inc., 1731 Belmont Ave., Chicago.

Saw

Metal-cutting, band. Two sizes, 4 in. and 8 in. Portable. Plugs into lighting socket. Claimed accurate to less than 0.005 in. thickness. The Wells Mfg. Corp., Three Rivers, Mich.

Fire Extinguisher

"Machine-gun" type. Has pump on outside of cylindrical container to avoid gumming up, jamming, or corrosion. Pump never comes into contact with liquid. Compressed air forces liquid out. Liquid container hermetically sealed when not in use. In action, pump is raised quickly, which opens sealing valves. Valves close automatically when pump is lowered. Wil-X Mfg. Co., 29 Ryerson St., Brooklyn, N. Y.

Geared Motor Reducer

Upright, inclosed, variable-speed. Ratings up to 15 hp. Standard variations (infinite): 2 to 1, 3 to 1, and 4 to 1. Called "Vari-speed." "Slo" or "Hi Speed" gears on output shaft furnished if desired. Sterling Electric Motors, Inc., Los Angeles, Calif.

Strip Test

For determining thickness of cadmium plating. Two solutions; 5A and 5B, are poured into testing cups. Alternate 15 sec. immersions tell thickness in increments of 0.00005 in. Enables testing for minimum thickness of plate as well as average. Udylite Process Co., Detroit.

Ammeters

"Tong-Test." For readings up to 800 amp. Instruments up to 400 amp. suitable for both d.c. and a.c. 800-amp. size operates on either a.c. or d.c., but not on both. All instruments give readings without interrupting circuit. Do not require current transformers or shunts. Columbia Electric Mfg. Co., 4519 Hamilton Ave., Cleveland.

Cement

Chrome-base, refractory. Shipped in prepared, ready-to-use form in 250-lb. and 500-lb. metal drums with air-tight, replaceable, full-opening covers. Called "Adachrome Super-Cement." Component materials claimed not to settle in drum or mortar box. Said to be chemically neutral, resistant to slags, fusible coal ash, and other fluxing fuel ingredients, impenetrable by molten metal. Botfield Refractories Co., Swanson & Clymer Sts., Philadelphia, Pa.

Floor Surfacer

Called "Tremtead." Combination of waterproof and elastic non-asphaltic gums and hard, non-slip aggregates. Applied over priming coat of special gum. Sets ready for traffic in 36 hours. When applied over wood, concrete, stone, marble, steel, slate, magnesite, glass, or tile, claimed to form tough, durable, non-slippery surface. May be used outdoors. Said to be unaffected by oil and grease. Standard colors are black, buff, stone, green, and red. The Tremco Mfg. Co., Cleveland.

Strainer

Phillips. For cleaning water used in general service around industrial plants. Backwashing feature permits strainer to be cleaned while in operation without removing strainer basket. Unit comprises two baskets placed at 90-deg. angle. Flow controlled by two swinging gate valves. Strainer basket is perforated cylinder, top and bottom open. Freyn Engineering Co., 310 South Michigan Ave., Chicago.

Remote Control

For arc-welding machines. Known as "Lincontrol." Permits operator to work at any distance from machine yet regulate current without going to machine. Control involves use of no additional cables or rheostat. Mechanism is incased in small box attachable to

welder voltage control. Regular hand controls may still be used. The Lincoln Electric Co., Cleveland.

Bearing

Shielded. S.A.E. standard No. 203. Shield retains lubricant, prevents dust or dirt from entering. The Bantam Ball Bearing Co., South Bend., Ind.

Safety Stair Tread

Alundum Rubber Bonded Safety. Now available in three colors—red, green, and buff—in addition to black originally offered. Same features and sizes as original black. Norton Co., Worcester, Mass.

Nickel Process

High gloss. Electro-deposition. Claimed to give thick brilliant deposits even at high current density in efficient, stable electrolyte self-sustaining from

anode. Also claimed to eliminate subsequent polishing or color-buffing, re-racking or re-cleaning previous to chromium plating. Developed and being licensed by Pyrene Mfg. Co., Metal Finishing Division, 360 Belmont Ave., Newark, N. J.

Hoist

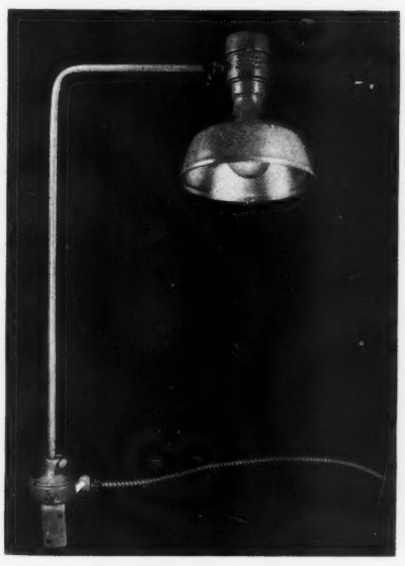
Spur - geared, chain. Improved model. Changes include zinc coating of all exposed parts; addition of precision ball bearings with integral grease seals supporting moving parts. Wright Mfg. Division, American Chain Co., Inc., York, Pa.

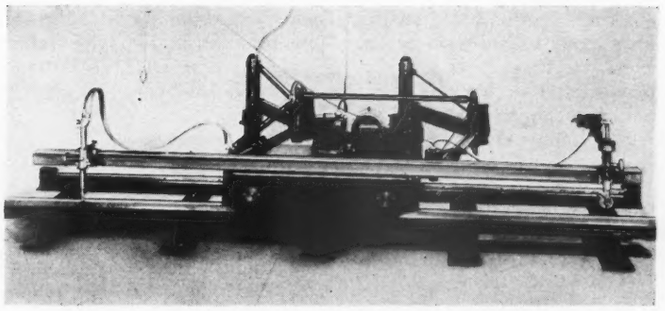
Gage

Vacuum. Called "Model No. 6 Tru-Vac." For use on vacuum pumps or vacuum system. Also indicates pressure of gas-filled devices. Dials calibrated in microns. May be used in connection with recording device. Continental Electric Co., St. Charles, Ill.

Reflector

Floodlight dome type, designed for flexible illumination of machinery. Called "Machinery Flexo-Dome Unit." Reflector is aluminum with special reflecting surface. Unit is portable, fire and weatherproof, has own wiring system, and independent switch. Feed wires from bulb socket and reflector run down through rigid hollow tubing set upright about 25 in. high, which forms stand, into base-box with switch, and out through 3 ft. of flexible tubing for connection with supply wires at conduulet or outlet-box. Reflector may be adjusted to any angle. Stops prevent complete revolution of unit. Attached to machinery by means of brackets. Wuelker Reflector-Lighting Corp., San Francisco, Calif.





Gas Cutting Machines

Two units, designated as Airco-DB No. 7 Oxygraph and the Airco-DB No. 1 Travograph. Pantograph construction of No. 7 Oxygraph has fourth side of parallelogram removed to rear, allowing working ends of arm to swing between vertical posts which support pantograph assembly, as well as in back of them. No tracer bar. Tracer attached to end of one pantograph arm, cutting torch to end of other. Single-torch operation only. Adapters for manually controlled or magnetic tracing.

No. 1 Travograph has pantograph assembly mounted on carrier that travels on rails, giving extended cutting area. Has long tracer bar attached to outer ends of pantograph arm. Tracer mechanism and cutting torch holders mounted on tracer bar may be moved to any position along bar and secured by set screws. Up to six cutting torches may be mounted on bar for multiple cutting. Can be operated with either manually controlled or magnetic tracer. Automatic control of carrier driving motor by movement of pantograph arm.

Both units equipped with variable-speed motors. Will cut steel plates, slabs, billets, and forgings. No. 7 Oxygraph has cutting area of 30-in. square or 36-in. diameter circle. No. 1 Travograph has cutting area 4½ ft. wide, 11 ft. long, with one 16-ft. section, or any length with additional rail sections. Air-Reduction Sales Co., 16 East 42nd St., New York.

Steel Moldings

Mitchell Specialty Co., Holmesburg, Philadelphia, Pa., announces entry into manufacture of steel moldings and rolled shapes, either in straight lengths or bent form and in variety of cross sections.

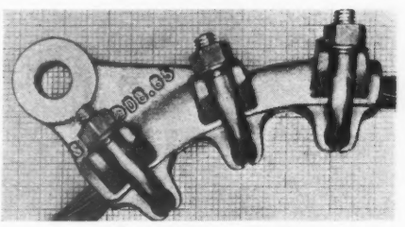
Lamp

Tubular. Called "Lumiline." Metal contacts on ends permit use end-to-end, forming continuous line of light. Has single stretched-coil filament drawn out in continuous line from one end-contact cap to other. Channel backbone inside bulb carries filament along tube. Wire filament supports anchor filament to backbone every 2 in. Available clear or with diffusing coating. Voltage, 110, 115, 120; wattage, 30- and 60-watt; maximum overall length, 17⅞ in.; diameter of bulb, 1 in.; life, 1,500 hours. General Electric Co., Nela Park, Cleveland.

Stapler

Flexible, foot-operated, for bags with small or bulky content. Adjustable to take one, two, or three stapler heads. Positions of staplers instantly adjustable for different spacing between staples. Available for any height required. Provision for extension table at right and left sides. Capable of inserting staple in bag less than ½ in. from product within bag. The Bates Mfg. Co., Orange, N. J.

Clamp



Strain and dead-end. For industrial service. Built on principle of compression and distortion of cable strands. Four sizes from 1/0 to 2,000 Mcm., weight from 3 to 11 lb. Pull-out or slippage values from 6,550 to 18,600 lb. Clamps can be used with clevis or ball-and-socket strain insulator units. Delta-Star Electric Co., Chicago.

Fuse Cutout

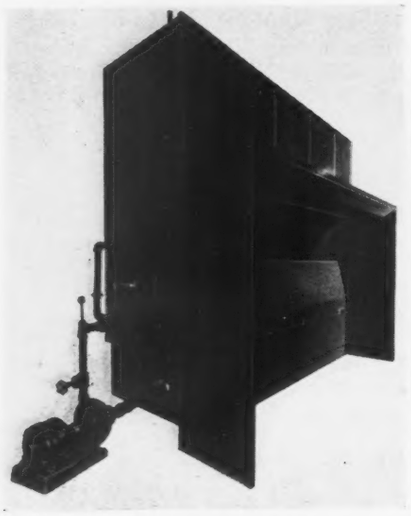
Indicating. Called "Fuse-O-Lite." Parallels older lines of plug and cartridge porcelain cutouts and is interchangeable with them. When fuse blows, Neon lamp glows, indicating where blown fuse is. L. S. Brach Mfg. Corp., Newark, N. J.

Expansion Joint

Adsco piston ring. Slip type. For preventing line pressure in steam or other piping from reaching stuffing box

during repacking operation. Consists of two piston rings mounted in piston head attached to inner end of slip. Back of piston head in body is relief chamber vented by piping leading away from expansion joint. When necessary to repack joint, valve in vent piping is opened and pressure between piston head and stuffing box is relieved. Available in all pipe sizes, for all operating pressures. American District Steam Co., North Tonawanda, N. Y.

Water Booths



Designed to prevent discharge of heavy, solid, sticky paint residues to outside of buildings. May be operated in neighborhoods where use of standard fan or blower type booths would be prohibited. Has opposed-direction sprays, first directed with and then set against air flow to secure separation of solids. Eliminator plates, equivalent to six 10-deg. angles, for removing free water from discharge air at low velocity. Water-tight doors provide access to all sprays, strainer, overflow, valves, and eliminator chamber. The DeVilbiss Co., Toledo, Ohio.

Lamp

Tubular. Based at both ends. Flat disk construction. Known as "Lumiline." Tungsten filament construction in T-8 bulb 1-in. diameter, overall length 17⅞ in. Available as 30- and 60-watt lamps, both designed for average life of 1,500 hours on 110-120 volts. To be available also as outside frosted bulbs of various colors. Westinghouse Lamp Co., Bloomfield, N. J.

Manometer

Automatic. Adaptable for direct and differential control for pumps, liquid levels in tanks and sprinkler sytems, for maintaining gas pressure and flow between close limits, or for starting and stopping flow in two pipes alternately. Visible reading of performance at all times. The Meriam Co., Cleveland.

Welder

Direct-current, 400 amp., driven by 25-hp., 230-volt, d.c. motor. Unit frame construction. Polarity reversed by turning thumb switch. Designed for either bare- or coated-electrode service. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Boilers

Miniature, electric-heated. Capacities from 2 to 18 kw., equivalent to 6 to 54 lb. of steam by weight generated per hour. Available for 0-100, 0-200, and 0-300 lb. gage steam pressure gage. Commonwealth Electric & Mfg. Co., 83 Boston St., Boston, Mass.

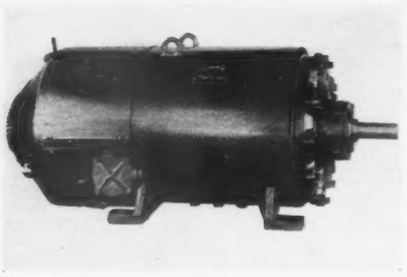
Switch

With receptacles and pilot light, combined in single gang wall box. Called "Timesaver." All-Bakelite bases. Fully inclosed and sealed. Variety of combinations. Arrow Electric Div., The Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Respirators

For protecting workers against inhaling lead, silica, dust, and spray mist. Called "M" series. Direct-breathing intake, coarse aluminum-bound wire screen. Positive gas-mask-type exhaust valve. All-rubber, adjustable headband attached to swivel joint. Does not interfere with wearing of goggles. Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn, N. Y.

Motor



D.c., fan-cooled, explosion-proof. Three removable screw caps provide for inspection of commutator and brushes. Rated 25 hp. at 806 r.p.m. The Louis Allis Co., Milwaukee, Wis.

Condenser

Type HP-504, heavy duty. Employs baffle arrangement for removing oil and water from air. Built of black iron pipe. Inlet and outlet openings located in top cover. Air passes down through pipe to condensing chamber, where moisture and oil are precipitated to bottom of condenser, and may be drained off. The DeVilbiss Co., Toledo, Ohio.

Flooring

Heavy duty, asphalt, tile. Claimed resistant to indentation and abrasion, able to withstand exposure to moisture. Can be applied directly over smooth wood sub-floors, and may be used for installations where dampness may be encountered. Supplied in four colors—black, red, mahogany, and brown. Tiles are 9x9 in., up to 12x24 in.; thickness, ¼ in. Johns-Manville, 22 East 40th St., New York.

Trade Literature

AIR CONDITIONING — Catalog, "Industry Freed of Weather Hazards by Sturtevant Air Conditioning."—Sturtevant Cooling & Air Conditioning Corp., Hyde Park, Boston, Mass.

CAPACITORS — Bulletin GEA-77F, "Improving Power-Factor for Profit." Describes G-E pyranol-treated capacitors. — General Electric Co., Schenectady, N. Y.

CEMENT—Bulletin No. 306, "Q-Chrome Neutral-Base Refractory Cement for Furnace Construction and Maintenance." — Quigley Co., Inc., 56 W. 45th St., New York.

CHAINS — Book, "Chains and Sprockets for Power Transmission — Conveying — Elevating." — Baldwin-Duckworth Chain Corp., Springfield, Mass.

COMPRESSORS—Bulletin AC-7, description, prices, information about air-cooled compressors for Diesel and gas-engine starting. —Gardner-Denver Co., Quincy, Ill.

COMPRESSORS — Leaflet L-611-S9, "Worthington Refrigeration Compressors." Horizontal single type, belt-driven, direct-connected to motor, steam-driven. — Worthington Pump & Machinery Corp., Harrison, N. J.

COUPLING — Bulletin, describes Falk-Rawson 4-Duty Coupling. — The Falk Corp., Milwaukee, Wis.

DRIVES, CONVEYORS — General catalog, 1024 pages, with list prices. Handbook of information on mechanical conveying, preparation of materials, transmission of power.—Link-Belt Co., 910 S. Michigan Ave., Chicago.

ELECTRIC HEATING—Bulletin GES-787B,

(Continued on advertising page 64)

Announcing SKILSAW DRILLS

HUSKIER – more power delivered under load.
SMOOTHER – 100% ball bearing construction.
FINER, – with less weight because die cast.

INVESTIGATE: Point by point, these new Skilsaw Drills, with their brilliant advancement in engineering design, outstrip the field in performance. Try them first!

SKILSAW, INC. · 3318 Elston Avenue · Chicago

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Condor Compensated

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TRADE MARK

SHORT CENTER IDLER DRIVE HIGH SPEED OPERATION . . .

"The most satisfactory belt we have ever used"

Condor Compensated Belts are made for severe drives like the one illustrated. High starting torques are safely handled, and high speed operation gives an economical increase in production.

Due to the remarkable flexibility and strength of Condor Compensated, it is a satisfactory general-purpose belt. It may be specified in 1 to 2 plies heavier than conventional belts—thus a bigger and stronger belt does the work that has been wrecking a lighter belt.

A trial of Condor Compensated will convince you.

Sold by leading jobbers

NRA MEMBER U.S. WE DO OUR PART

Condor LINE

Transmission Belt	Fire Hose
V-Belt	Hydraulic Hose
Conveyor Belt	Steam Hose
Air Hose	Water Hose
Contractors Hose	Chute Lining
Sand Blast Hose	Launder Lining
Suction Hose	Industrial Brake Blocks

THE MANHATTAN RUBBER MFG. DIVISION

OF RAYBESTOS-MANHATTAN, INC.

EXECUTIVE OFFICES AND FACTORIES, PASSAIC, NEW JERSEY

3 MINUTES *to answer this one*

1. WHAT MANUFACTURER of Materials-Handling Trucks, Tractors, Cranes, and related equipment, began in 1930 to increase its Engineering Staff, and built up until in 1933 its Engineering Department (always *big enough*) was largest in Company's history?

2. WHAT MANUFACTURER has, as the result of this sound and deep Engineering work, produced a line so well-developed and constantly being improved that it is literally *all new*—even though the maker has been in the truck business for more than 25 years?

3. WHAT MANUFACTURER builds power industrial trucks exclusively, on a large scale?

4. WHAT MANUFACTURER now makes the most models; the most types of a particular model; and in the highest-rated capacities?

5. WHAT MANUFACTURER, after a business lifetime as the Industry's producer of Electrics, takes the lead in developing Gas and Gas-Electric Trucks?

6. WHAT MANUFACTURER now has completely-tested, proved, *new* types in all three—not in pictures, but sold and at work?

7. WHAT MANUFACTURER has developed attachments which adapt his machines to almost every industrial demand: picking up, elevating, carrying, tiering, charging; or can build on specification to meet the most unusual requirements?

8. WHAT MANUFACTURER believes that one of the greatest single methods of saving money in materials handling is by handling loads on pallets; and

9. WHAT MANUFACTURER has developed so complete a line of Trucks with Telescoping Uprights for pallet-handling; capable of carrying loads under speed for any distance; "ducking" low doorways yet reaching for the roof in warehouses; pulling powerfully up-grade yet traveling down under full control?

10. WHAT MANUFACTURER regards his clients' present material-handling problems as *new* problems, originating in 1934—and sets out to meet them in the most modern, *saving* ways?

11. WHAT MANUFACTURER'S service records show that costs for repair parts for the machines he sold from 1 to 20 years ago, average only $6.00 per month per machine?

12. WHAT MANUFACTURER knows that, from all available records, at least 95% of all the machines he has sold during 28 years are still in service?

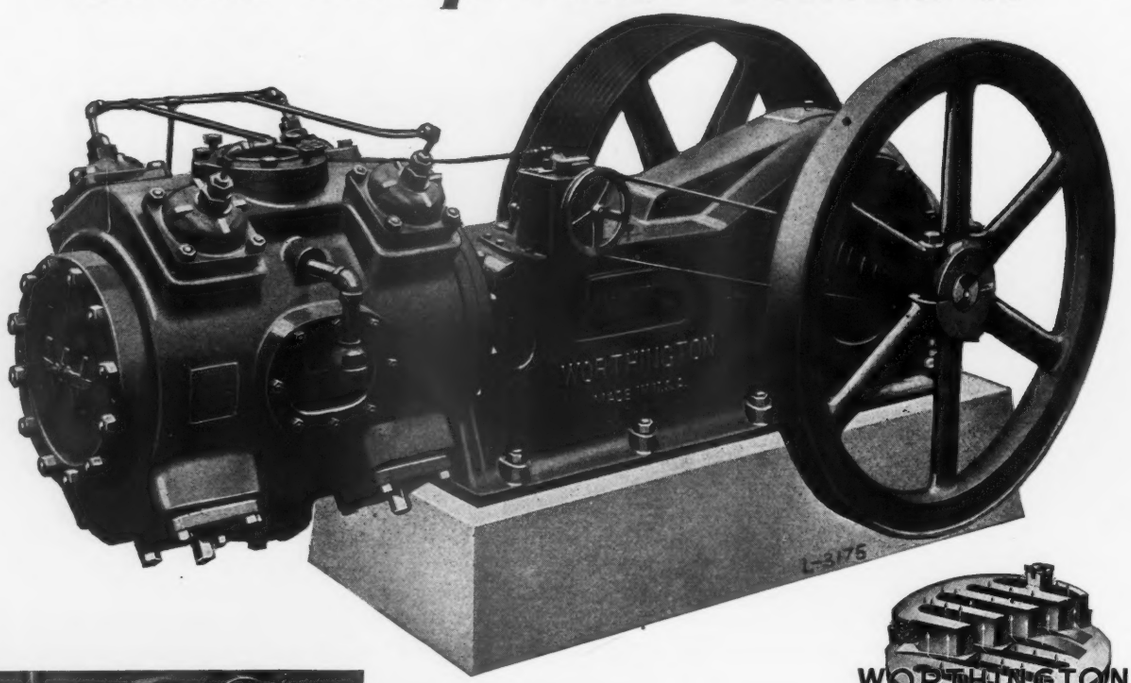
13. LUCKY QUESTION! What manufacturer is keeping his identity no secret, nor witholds any facts about the ability of his product to do big, useful, money-saving jobs in every industry where materials have to be picked up, carried, put down again safely, quickly, and in volume?

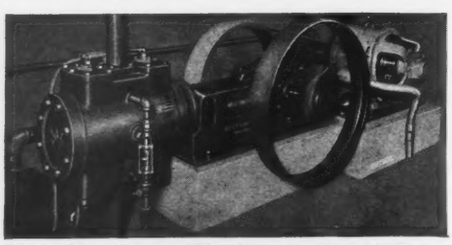
Answers to *all* these questions will give you more appreciation of the high standards to which new Elwell-Parker Trucks are being built, and what they are doing in industry.

For information about what "Elwell-Parkers" will do in your work, just describe your own handling job in enough detail to give our Engineers the general idea, and address The Elwell-Parker Electric Company, 4323 St. Clair Avenue, Cleveland, Ohio.

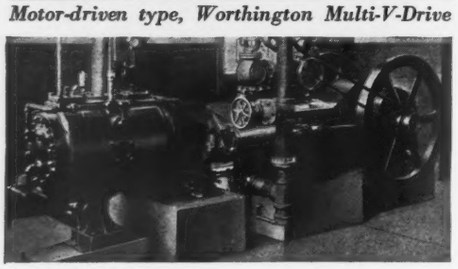
New ELWELL·PARKER *trucks*

Your Compressed Air Supply *is only as dependable as the compressor behind it*





Motor-driven type, Worthington Multi-V-Drive



Steam-driven type

Capacities **78 to 1292 cu. ft. per min.**
Pressures **up to 150 lb. per sq. in.**

EQUIPPED

WORTHINGTON HORIZONTAL SINGLE-STAGE AIR COMPRESSORS . . . in hundreds of plants where uninterrupted day-in and day-out service is demanded . . . are making unsurpassed records for continuous, efficient low-cost performance.

Design features which are unexcelled . . . completeness of line . . . together, provide the solution for any compressed air problem, *however exacting,* within the range of these units.

● ***New illustrated literature now available***

WORTHINGTON PUMP AND MACHINERY CORPORATION

General Offices: **HARRISON, NEW JERSEY** - *Branch Offices or Representatives in Principal Cities throughout the World*

NRA A-3410

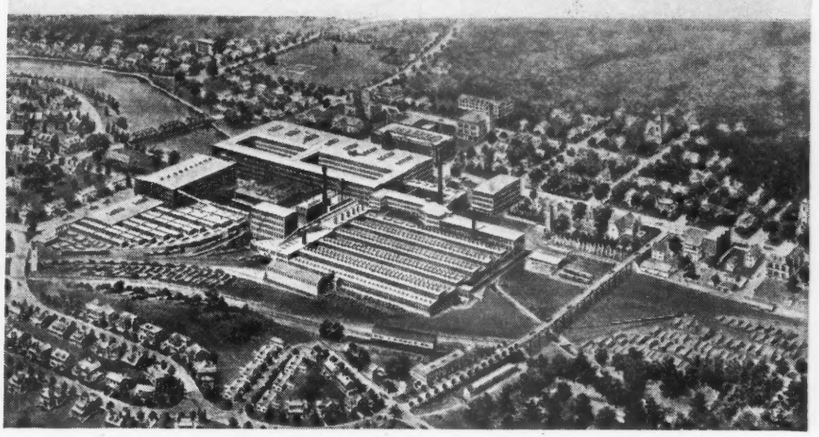
WORTHINGTON

ATLANTA BOSTON BUFFALO CHICAGO CINCINNATI CLEVELAND DALLAS DENVER DETROIT EL PASO HOUSTON KANSAS CITY LOS ANGELES NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH ST. LOUIS ST. PAUL SAN FRANCISCO SEATTLE TULSA WASHINGTON

THE CHOICE IN DRAPER'S HUGE HOPEDALE PLANT

Lastingly white Barreled Sunlight used since 1919 by this noted manufacturer of textile machinery

● Plant of the Draper Corporation, Hopedale, Mass. Painted throughout for lasting cleanliness and light with Barreled Sunlight.



14 YEARS AGO, Draper Corporation, of Hopedale, Mass., painted their tremendous plant which covers more than 33 acres of floor space! Naturally, with such an enormous ceiling and wall area involved, Draper could afford no mistakes in their interior paint job. They painted throughout with 20,000 gallons of Barreled Sunlight.

As evidence of Draper's complete satisfaction with the lasting whiteness . . . the continuously high light-reflecting properties of Barreled Sunlight . . . since 1919 they have bought many thousands of additional gallons!

The Secret of Lasting Whiteness

Why does Barreled Sunlight hold its whiteness when other white paints soon turn a dingy, light-stealing yellow? Look at the vials below! Then read the statement which is Your Surety that Barreled Sunlight will remain white *longest* upon your ceilings and walls.

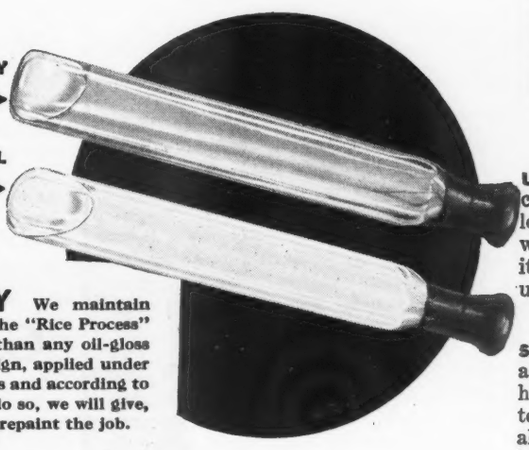
Low Application Costs

Initial costs of painting with Barreled Sunlight are relatively low. It is one of the easiest working of paints. Its spreading and covering powers are tremendous . . . One coat of Barreled Sunlight equals two of ordinary paints. Time, labor and paint costs are thus reduced.

Repeated washings do not harm the flawlessly smooth, dirt-resisting surface of Barreled Sunlight. Hence frequent repainting . . . the only remedy for less durable or for yellowed paint . . . becomes unnecessary.

To increase plant efficiency and reduce spoilage through improved lighting conditions . . . to get a white paint job that will *remain* white—paint the interiors of your plant with Barreled Sunlight.

Send for further information contained in the booklet, "More Light with Lasting Cleanliness." Address U. S. Gutta Percha Paint Company, 2-E Dudley Street, Providence, R. I. (For Pacific Coast, W. P. Fuller & Co.) Branches or distributors in all principal cities.



REFINED LINSEED OIL COMMONLY USED IN WHITE OIL PAINTS. NOTE YELLOW COLOR. ➔

THE SAME REFINED LINSEED OIL AFTER "RICE PROCESSING." PRACTICALLY COLORLESS. ➔

UPPER VIAL shows refined linseed oil commonly used in white paints. The yellow color disappears when this oil is mixed with white pigments. But don't be fooled, it is still there . . . sooner or later to appear upon your ceilings and walls.

● ● ●

SAME OIL treated by the "Rice Process" appears as shown below. The "yellow" has been *taken out*, not just bleached to temporary whiteness! The "Rice Process" also gives Barreled Sunlight its remarkable hiding power . . . ease of flow.

YOUR SURETY We maintain that Interior Barreled Sunlight, the "Rice Process" white, will remain white longer than any oil-gloss paint or enamel, domestic or foreign, applied under the same normal service conditions and according to our specifications. If it does not do so, we will give, free, enough Barreled Sunlight to repaint the job.

SCHIEREN-IZED

The Belt that has IT

IT is the ability of a belt to grip the pulleys without excessive tension.

Clamp a bucket of water to the end of a belt which has been hung over a stationary pulley.

With a SCHIEREN Belt, the bucket can be held in place by the little finger, without slipping.

That's what SCHIEREN means when they refer to the gripping power of SCHIEREN-IZED belt surface.

And after all, it's that extra gripping power which transmits the extra horsepower.

Let us send you some details on this improved belt.

Chas. A. Schieren Company

Tanners and Manufacturers of

LEATHER BELTING, PACKINGS and SPECIALTIES

MAIN OFFICE AND FACTORY

72 Ferry Street New York, N. Y.

SCHIERENIZING
Puts a grip
in Belting

(Continued from editorial page 215)

to engineers and designers. Book tells about methods of welding, riveting, forming, machining, finishing.

• VITAMIN D, according to the makers of a new concentrate that's many times more potent than high-grade cod liver oil, is easily incorporated into foods without imparting fishy odor or taste.

• NO NAILS are used to lay a new type of wood flooring. Metal channels replace wooden sleepers; metal clips, slipped into the channels, are driven into the boards as they are laid.

• A PLASTIC MATERIAL which adheres firmly to metal and brick surfaces provides effective insulation for boilers, electric furnaces, etc. Works good up to 1,700 degrees Fahrenheit. Coverage, 1,400 square feet to the ton when applied 1 inch thick.

• GREAT POSSIBILITIES in the manufacture of a whole new line of copper alloys have been opened by the discovery of a new way to harden and strengthen them simply by the application of heat.

• SOMETHING different in cartons is the three-sided one used to package a new cereal composed of wheat hearts blended with a "chip bran" and protein from wheat kernels.

• NOISE is kept out, fresh air is let in, by a shutter that can be attached to existing windows or built into new ones.

• DRAFTSMEN can throw away loose T-squares, triangles, protractors, etc. A compact drafting machine, combining these and other tools, can be attached to any drawing board.

• WATER - PROOF CARTONS, packed with cans of oil, were recently towed around New York harbor, then tied to a pier and left about 85 per cent submerged for 72 hours and 15 minutes. They were still waterproof after this rough treatment.

• SOUTH WALES reports a machine that weighs and sorts tinplate automatically. Two men can carry it.

• MALIUM GAS, if you have fumigating troubles, is clean, non-inflammable, has no persistent odor.

• LIGHTING CHECK CHART, issued by a lamp manufacturer, enables you to check plant lighting against recommended lighting intensities, gives correct reflector sizes for given wattage. It's for better seeing.

• ADHESIVE PRECOATING, used on collapsible tubes, provides an airtight and leakproof closure. In tests recently made, most of the tubes burst before the closure gave way.

MOTION AND TIME STUDY

THE BASIS OF INFORMED MANAGEMENT

INSTRUCTION and TRAINING

With the development of a scientific motion and time study technique, Methods Engineering has become a profession. The Methods Engineering Council, with the cooperation of the authors of the book, Time and Motion Study and Formulas for Wage Incentives, has developed courses designed to produce Methods Engineers thoroughly trained in the latest and most advanced motion and time study practices. A booklet describing courses and other services will be sent upon request.

CONSULTATION and INSTALLATIONS

METHODS ENGINEERING COUNCIL, INC.
Wood and Franklin Streets, Station 21, PITTSBURGH, PA.

GITS

Constant Level OILERS

Maintain correct oil level. Prevent burning out of motors and bearings.

Furnished in both hinged and removable bottle types. Capacity 5/8 to 32 ozs. Write for catalogue.

EASILY FILLED

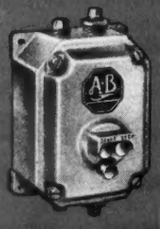
GITS BROS. MFG. CO.
1848 South Kilbourne Ave. CHICAGO

For general industrial and machine tool service.

STANDARD DUTY

For bottling plants, breweries, dairies, etc.

WATER-TIGHT, WEATHER-PROOF



For dusty applications such as grain elevators.

DUST-TIGHT

For motor control in explosive atmospheres.

EXPLOSION-PROOF

For operation in corrosive or explosive atmospheres.

CORROSION-PROOF

BULLETIN 709

THE WORLD'S MOST MODERN STARTER

AVAILABLE for Every Class of Service

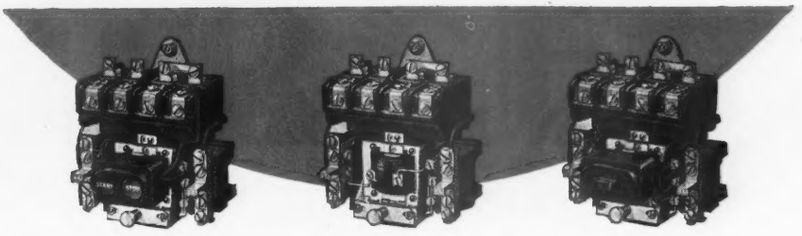
The new Bulletin 709 starter—the pacesetter for all across-the-line starting switches—is now ready for every type of industrial requirement. Also, the feature of small size with ample wiring space, found in the standard duty starter, has been retained for all applications.

With 18 types and models, there is now a standard Allen-Bradley starter for any type of machine or service. Pick what your job requires from the standard Bulletin 709 line, including auxiliary control stations, limit switches, and other accessories.

The Bulletin 709 solenoid-operated automatic starter, with double-break contacts, rubber grommet mounting, and overload relays, has established a new standard in starters for motors up to 3 H. P., 110 V; 5 H. P., 220 V; and 7½ H. P., 440-550 V. Every engineer and designer should know all about the complete Bulletin 709 line. Send for Bulletin 709.

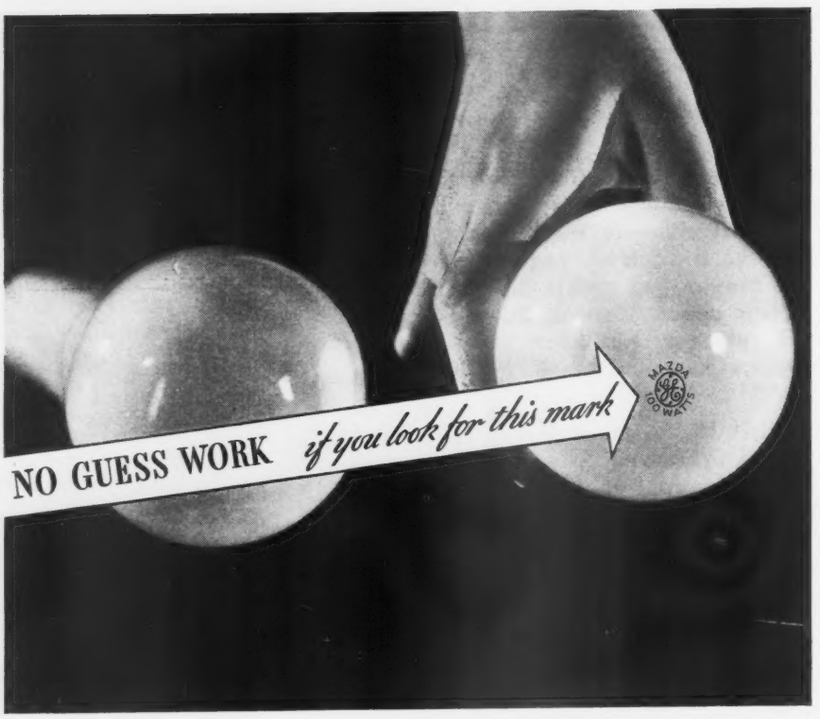
ALLEN-BRADLEY CO.
1321 S. First Street Milwaukee, Wis.

ALLEN-BRADLEY



THREE FORMS MEET EVERY INDUSTRIAL NEED

Make your Lamps show their *Credentials*



WHEN you buy an incandescent lamp you are investing in a device for turning electric current into light. The cost of the lamp itself is only a fraction of the total cost of light. That is why it is so important to look for an identifying mark of quality on every lamp you buy for your office, your factory, or your home. When you buy lamps that bear this famous mark you are sure of getting all the light you pay for.

CHECK UP ON YOUR LIGHTING

This amazing little instrument measures light as accurately as a thermometer measures heat. It indicates how much light you need for various visual tasks in office or factory. Ask your lighting company for a demonstration, or write General Electric, Nela Park, Cleveland, Ohio.

EDISON MAZDA LAMPS

GENERAL ELECTRIC

(Continued from advertising page 36)

fore we can say that business, is getting back where it should be.

Higher wages are not an additional cost under proper management. Better-paid workmen are more willing and more efficient. Better material is not necessarily more expensive; on the contrary, it is always more economical.

Last year at lower wages was more costly to industry than this year at higher wages, because last year we were paying wages that produced nothing and this year our wages are beginning to give promise of a return. HENRY FORD

Company Unions

The company union is an agency developed by management for the purpose of more effectively dealing with employees to accomplish management's purposes. It is so organized and operated that the employer's control over jobs is all-pervading.

The situation now resolves itself into this form. The law says employees have the right to organize. Shall they control their own organizations, or shall the employers control them? WILLIAM GREEN

The company union has failed dismally to standardize or improve wage levels, for the wage question is a general one whose sweep embraces whole industries, or states, or even the nation. Without wide areas of cooperation among employees there can be no protection against the nibbling tactics of unfair employers or of the worker who is willing to degrade standards by serving for a pittance.

The company union is generally initiated by the employer; it exists by his sufferance; its decisions are subject to his unimpeachable veto. Most impartial students of industrial problems agree that the highest degree of cooperation between industry and labor is possible only when either side is free to act or to withdraw, and that the best records of mutual respect and mutual accomplishment have been made by employers dealing with independent labor organizations.

ROBERT F. WAGNER

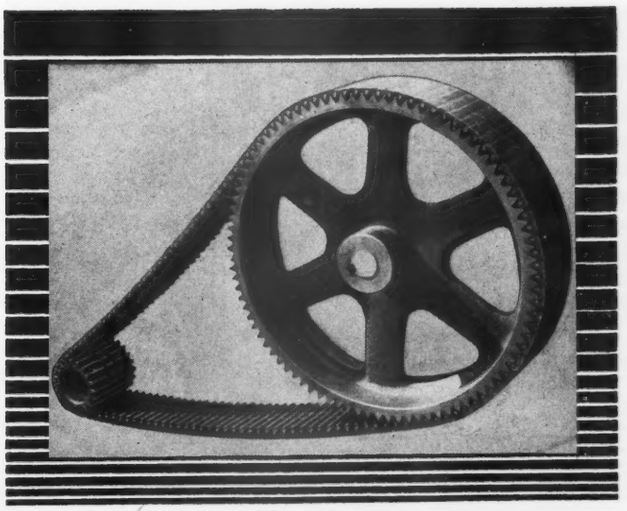
A certain percentage of labor troubles has been due to disagreement between unions as to the classification of work properly belonging to each. Plainly, any such disputes are beyond the decision of company management, yet they frequently result in strikes and loss of wages to employees in other departments even though the management is entirely innocent either of provoking the trouble or championing either side after it has arisen.

Herein lies one of the advantages of employee representation, in that while it insures representation to all employees by their own associates who understand their local craft problems, it avoids jurisdictional disputes between two crafts in the same organization. WALTER C. TEAGLE

Says the Administrator

We would and must have a supreme court of industrial relations. In my opinion, the government should not favor

FOR PERFECT FLEXIBILITY WITHOUT POWER LOSS USE

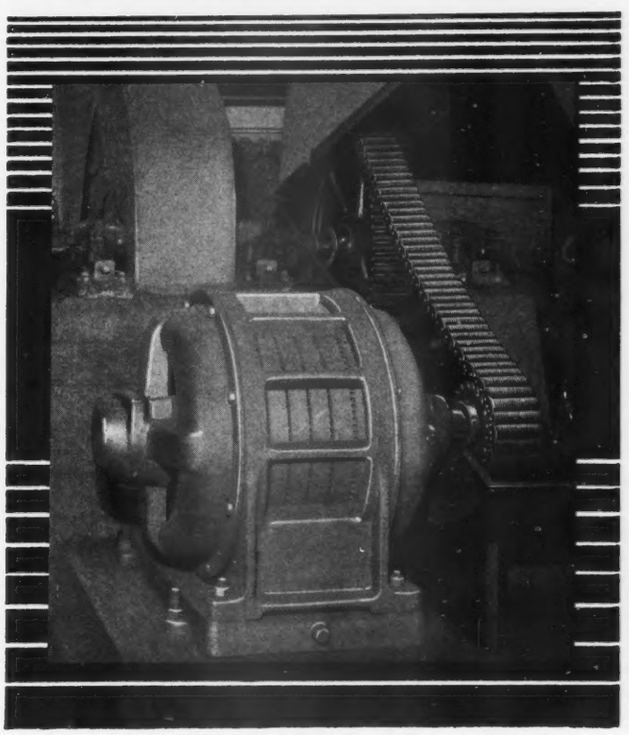


CHAIN DRIVES

Chain drives meet any transmission condition, can be applied to the centers you want; in fact, there's no form of transmission quite as satisfactory under all conditions.

For small drives or large ones, chain drives are superior over any other form of drive. They perform and, due to their low first cost and low maintenance cost, chain drives save money, decrease operating costs.

Our engineers will gladly cooperate with you in accomplishing definite results.



Silent Chain Drives
Morflex Couplings
Pullmore Clutches

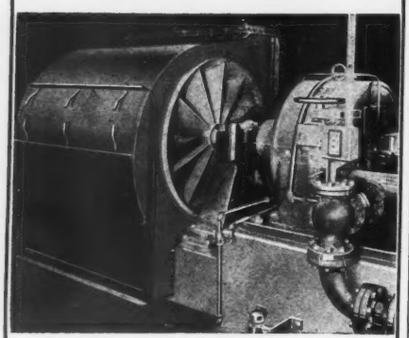
MORSE
CHAIN COMPANY

Roller Chain Drives
Morse Kelpo
Free-Wheeling Clutch

A Division of Borg-Warner Corporation

ITHACA • NEW YORK

Dividends from the Power Plant!



Many a manufacturer, operating on today's restricted volume, has potential profits going up the smoke stack! Literally, modernization of the power plant frequently results in astonishing savings due to better combustion and more uniform regulation.

Buffalo Forced and Induced Draft Fans, so generally used by the public service companies, are just as desirable for the private power plant. Numerous features of design and construction provide better efficiency, lower maintenance costs and longer life.

We have recently issued two illustrated bulletins showing Buffalo Forced and Induced Draft Fans, and will be glad to send you copies on request.

Buffalo Forge Company
171 Mortimer St., Buffalo, N. Y.
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

forced and induced DRAFT FANS

any particular form of labor organization. An informed labor democracy should settle the question of form for itself. On the other hand, while a company might initiate a form of "company union," its activity should stop there. It should neither finance, sponsor, or direct what the men do. The control of employment is so potent a force that there could be no freedom of choice under such a scheme.

HUGH S. JOHNSON

Unionizer

. . . the measure (Wagner bill) could be termed "A bill to unionize all business and industrial establishments," since it gives the National Labor Board and its regional labor boards and agents unrestricted power to declare as unfair labor practices nearly every act of an employer in his relations with employees.

It would abolish company unions, legalize and insure the closed shop throughout business and industry, and impose severe penalties for violation of any of its terms. Once passed, it would forever remove the last vestige of control an employer possesses over his labor costs, and in large part over the management of his business. It would create a labor party stronger in power and influence than either of the existing political parties. It would impose the will of approximately 10 per cent upon 90 per cent of the nation's employees.

GEORGE W. YOUNG
President, Chicago Association of Commerce

Unnecessary

The (Wagner) bill seems entirely unnecessary in view of the very broad interpretation given to Section 7(a) of the Recovery Act by the President in his settlement of the threatened automobile strike. All that is needed is a short amendment to Section 7(a) of the Recovery Act protecting the employee from coercion either by the employers, labor organizations, or others.

HENRY I. HARRIMAN
President, U. S. Chamber of Commerce

Armed to the Teeth

Industry's greatest threat (Wagner bill), clothed in dove-like garments by its sponsor, but in fact armed to the teeth with all the weapons necessary to annihilate the fruits of all U. S. industrial relations experience. Its strike-making possibilities could easily, and within thirty days after passage, destroy all good effects of the NRA, in fact, the entire movement. Industry has offered its greatest show of power against this bill and must continue to do so if it hopes to stop its passage.

CONNECTICUT INDUSTRY
April, 1934

Destructive

This measure (Wagner bill) is not only not necessary to, but probably destructive of the maintenance of mutually satisfactory relations between employers and employees . . . It would, we believe, set up a permanent third party to all employer-employee relationships, with full authority

Silent
Water Proof
Long Wearing

CELORON
SILENT GEARS

Celoron Silent Gears absorb shock and vibration, reduce wear on bearings and mating gears, insuring longer machine life. Celoron Gears are furnished by all leading gear cutters.

CONTINENTAL-DIAMOND FIBRE COMPANY
NEWARK, DELAWARE
CHICAGO
CLEVELAND
NEW YORK

Stop It Quick
with

Queen
UNDERWRITERS LABELED
FIRE
EXTINGUISHERS
FOR EVERY FIRE HAZARD

Don't let fire start. Protect your property with Queen Fire Extinguishers and Equipment. Leaders for 25 years. Approved by Underwriters' Laboratories, Inc.

Extinguishers and Parts for Every Purpose

Write for prices on new equipment, parts, refills.

HARKER MFG. CO.
Dept. FMM-5
121-123 W.3rd St.
Cincinnati, Ohio

Safety Supplies—Gas Masks, Goggles, etc.

From plant after plant comes the verdict . . .
"THIS IS THE FINEST BELT WE HAVE EVER USED"

GRATON AND KNIGHT

Good flat leather belting, properly installed and cared for, has always been one of the most efficient forms of power transmission. This fact, plus the low initial cost of this type of machine drive gives it a tremendous advantage over all others.

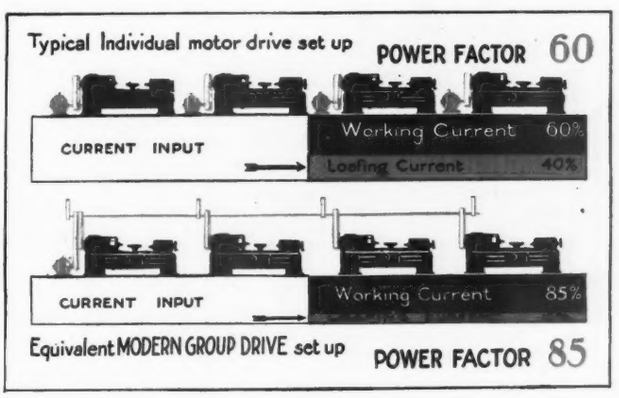
Now that Graton & Knight Research Belting has so greatly bettered the performance and economy of modern group drives as well as individual machine drives, its installation is a major factor in profitable plant modernization.

Not only does Research Flat Leather Belting run with little or no stretch, but because of its greater flexibility and new high friction surface, it pulls full loads without slip, without "breaking in" and with only normal tension and bearing pressures.

"This is the finest belt we have ever used," say hundreds of New Research Belt users. Performance facts support their statements. Our local power transmission man has carefully recorded operating data showing just what Research Belts are doing in your industry and others. He can show you immediate and worthwhile savings on a very small investment. Write Graton & Knight Company, Worcester, Mass.

HIGHLIGHTS of the MODERN GROUP DRIVE No. 4

How much loafing current on your payroll?



Indiscriminate use of individual motor drives is directly responsible for power factor troubles. Not only is the power factor for small induction motors normally lower than for larger units of the same type, but the motors on practically all individually driven machines operate underloaded, still further aggravating power factor troubles.

Modern Group Drive offers a logical solution to the problem of poor power factor without recourse to costly corrective equipment.

This chart is taken from a booklet published by the Mechanical Power Engineering Associates, and giving in non-technical form the results of a two-year study of the place and comparative economy of modern group and unit drive systems in Industry. We will be glad to send you a copy on request.

PERFORMANCE FACTS *tell why!*

Research belting, installed as a test on one of the 15 hp. fan drives in a series of cooling towers, proved so satisfactory that the other drives were at once similarly equipped. None of the belts has yet been shortened *after from two to three months continuous operation.*

●

After *a year and a half* of continuous operation on a short center 15 hp. vacuum pump drive, a 5" Research Belt in a tire company's plant shows only 2" stretch. Previous belt life on this installation was *from 2½ to 3 months.*

●

In a Philadelphia paper mill, the 28" Research belt on the turbine drive to a paper machine was shortened only 4" (.06%) about a week after installation. At the end of three months continuous operation this belt showed no further stretch. Horsepower of turbine, 260 with 25% overload capacity. Driving pulley 26"x30" face; driven pulley 33"x30" face; centers 23'1", 40° angle, tight side on bottom. Turbine speed 176 to 716 r.p.m.

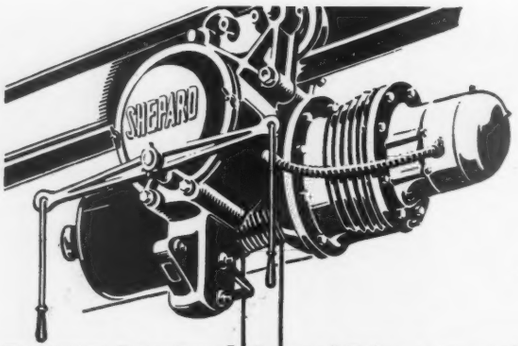
●

A St. Louis shoe company has some interesting Research belted, fixed, short center blower drives, which have been in operation over two years with highly satisfactory results. Centers are 20", the belts 3" singles driving vertically from 3 hp. motors 1750 r.p.m. with 4" driving pulleys and 12" blower pulleys. What little stretch has taken place has been easily compensated for by adjustment of the motors without removing the belts.

NRA

GRATON & KNIGHT *Research* LEATHER BELTING

GRATON & KNIGHT COMPANY . . . . . WORCESTER, MASS



EXCLUSIVE FEATURES: **1.** Balanced Drive, at two points diametrically opposite. **2.** Perfect alignment, maintained by all parts rotating around a common axis. **3.** Automatic Oil Bath Lubrication. **4.** Control by rope, push button, outrig or controller for every hoist. **5.** Precision variable speed control for both A. C. and D. C. **6.** Variety of speeds, types, lifts and capacities precisely suited to any service. *Write for complete data to SHEPARD NILES CRANE AND HOIST CORPORATION, 364 SCHUYLER AVENUE, MONTOUR FALLS, N. Y.*

SHEPARD

ELECTRIC HOISTS

PYROIL

(Simply Add to Regular Oil)

CUTS *maintenance* COSTS

Pyroil is the latest scientific achievement in lubrication. Simply *added* by the ounce to the regular oil and grease, it cuts friction, overheating, wear and damage because it sheaths all frictional metal with a heat-proof, wear-resisting surface of protection, which constantly renews itself. Actually *makes metal self-lubricating.* Cuts operation costs.

Mail coupon for a FREE COPY of new Pyroil Industrial Brochure, illustrating, classifying and tabulating many important Pyroil facts and uses.

Genuine Pyroil is Manufactured, Patented and Guaranteed by Pyroil Company, W. V. — Kidder, Pres., 373 LaFollette Ave., LaCrosse, Wis., U.S.A.

PYROIL COMPANY
373 LaFollette Ave., LaCrosse, Wis., U.S.A.

Please send a Free copy of the new Pyroil Industrial Brochure, as described.

Name .....
Address .....
City ..... State .....

Dolph's
TRADE MARK

ELECTRICAL INSULATING QUARTET

covers all requirements for maintenance and repair.

Dolph has taken the uncertainty out of the selection of insulating varnishes. Each member of the Quartet has been designed for a specific industrial maintenance need and can be depended upon to meet that need adequately.

1. **Dolph's Coil Black Air Drying—** for armature and coil insulation before assembling.
2. **Dolph's Black Finishing Varnish—** Air dries in thirty minutes and is a waterproof black finish for meter boards, cables, feeders, etc.
3. **Dolph's Electric Lacquer—** the standard oilproof varnish and waterproof black finishing varnish for 25 years.
4. **Dolph's Red Oilproof Enamel—** for use on mica cones and commutator ends to prevent trouble from oil creepage.

Write for descriptive pamphlet, and list of dealers who can supply you.

JOHN C. DOLPH CO.
Insulating Specialists
168 EMMETT ST.
NEWARK . . . . N. J.

to abrogate, nullify, or modify any and all arrangements and/or agreements which employers and employees may have developed.

NEW ENGLAND COUNCIL

Monopolistic

The Wagner bill, if enacted into law, would place in the hands of employees, in conjunction with the National Labor Board, monopolistic power that would effectually strip the employer of all means to bargain or negotiate with his own employees in the interest of industrial harmony and continuity of industrial operation. It would force unionization on workers whether they wanted it or not.

MAINE MANUFACTURER

For It

If it (Wagner bill) will prevent labor-exploiting by ruthless employers who chisel our prices.

RHODE ISLAND MANUFACTURER

Three's a Crowd

Our relations with our workers have always been mutually satisfactory and agreeable. This (Wagner) bill is a direct invitation for a third party to take part in any and all discussions regarding labor with a resulting premium on unrest and disagreement rather than on continuance of amicable relations.

NEW HAMPSHIRE MANUFACTURER

Protest

Business is coming in very well with us. We are running two full 40-hour shifts, with a total of 260 people working. Our firm has a record of 65 years of pleasant relationship with our employees, and we protest the passing of any bill tending to disturb and nullify that relationship.

VERMONT MANUFACTURER

Penalizes

This (Wagner) bill penalizes the employer for what the Board may regard as unfair practice without providing any penalties for unfair practices by employees.

MASSACHUSETTS MANUFACTURER

Will Tear Down

This (Wagner) bill will tear down nearly every act of good will that has been built up and fostered between industries and their workers during the last 25 years.

CONNECTICUT MANUFACTURER

Worst Over

It seems reasonable to suppose that the worst of the world depression passed some time ago, and that unless upset by some unusual circumstances improvement will continue.

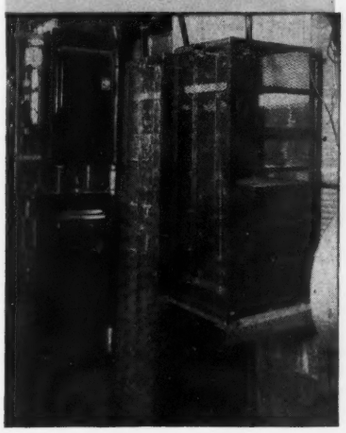
The rate of improvement may be accelerated or retarded by injecting into the picture abnormal influences, but the general trend will not be affected for the reason that an industrial recovery, like an industrial depression, is in a practical sense of the word, an irresistible force.

ALFRED P. SLOAN, JR.

HERE'S MORE PROOF

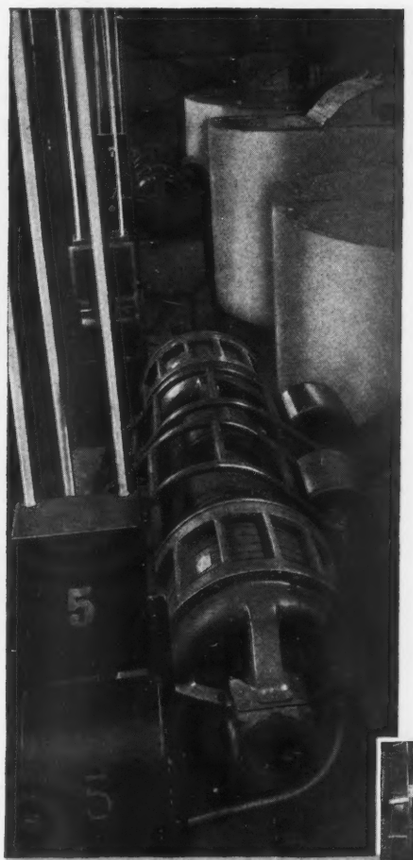
THAT POWER-FACTOR IMPROVEMENT REDUCES POWER COSTS

OVER $900 SAVED IN FIRST SEVEN MONTHS



THE Kennedy Valve Manufacturing Company, Elmira, N.Y., made an installation of 90 kv-a. of G-E capacitors early in June, 1933. Later in the same month they ordered 10 kv-a. additional capacity, and during July and August another 30 kv-a. was installed, making a total of 130 kv-a.

The month-by-month savings in power costs made possible by power-factor improvement totalled $911.90 for the first seven months of operation. At this rate the equipment will pay for itself the first year. This installation is typical of many in our files which show substantial savings effected by power-factor improvement with G-E Pyranol capacitors.

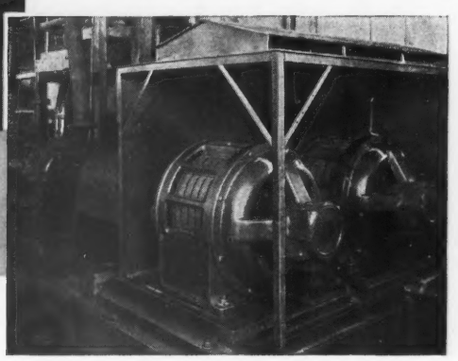


SAVED $3,800 ANNUALLY

SEEKING ways to reduce operating costs, the California Fruit Wrapping Paper Mills, Inc., of Pomona, California, found, after a thorough plant analysis, that modernization with G-E synchronous motors and control would save $3,500 to $3,600 annually on the plant's power bills by improving power-factor and increasing efficiency.

The cost of the equipment for this installation was $11,700. Annual savings were found to exceed expectations, actually amounting to $3,800 annually.

Mr. F. O. Fernstrom, President of the company, says: "This equipment has been in operation seven months, and we find the expected savings have been exceeded and represent 32 per cent return on the investment."



GENERAL ELECTRIC

In hundreds of cases, the installation of G-E power-factor improvement equipment — capacitors, synchronous motors, synchronous condensers — has improved plant operation and effected savings. In those cases where power contracts included a penalty for low power-factor and a bonus for its improvement, substantial returns have been made on the investment. Look into these savings. Simply fill in and mail the attached coupon; or, if you prefer, call the G-E sales office nearest you.

General Electric Company — GET-541 ☐ GEA-77F ☐
Dept. 6B-201, Schenectady, N. Y.

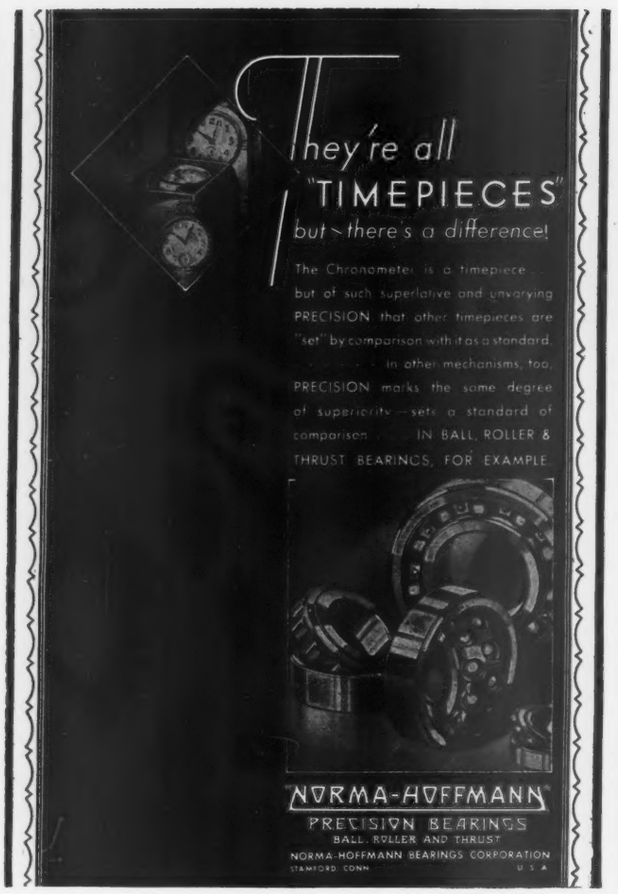
Please send me your bulletins "Direct-reading Power-factor Improvement Chart," GET-541, and "Improving Power-factor for Profit," GEA-77F, as checked above.

Name.....

Firm.....

Street.....

City..... State..... 060-1


They're all
"TIMEPIECES"
but—there's a difference!
The Chronometer is a timepiece
but of such superlative and unvarying
PRECISION that other timepieces are
"set" by comparison with it as a standard.
In other mechanisms, too,
PRECISION marks the same degree
of superiority—sets a standard of
comparison IN BALL, ROLLER &
THRUST BEARINGS, FOR EXAMPLE
NORMA-HOFFMANN
PRECISION BEARINGS
BALL, ROLLER AND THRUST
NORMA-HOFFMANN BEARINGS CORPORATION
STAMFORD, CONN. U. S. A.

Every Kind of

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[also Copper & Brass]

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Structural steel incl. rails, H Beams, etc.
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Joseph T. Ryerson & Son, Inc.

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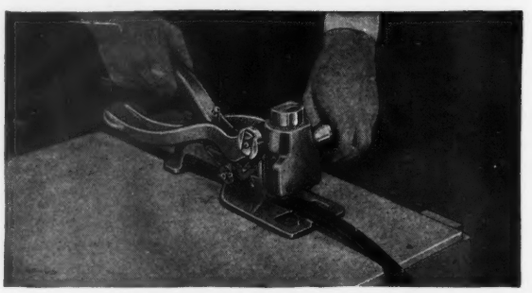
RYERSON

Stanley Improved "3 in 1" Strapping Tool



This latest model Stanley Tool combines in one unit the tightening, sealing and cutting operations, thus doing away with the now obsolete three-tool method.

Banding packages for safe transit and delivery has long since proven its tangible worth. We now offer a greatly improved tool that does the job *faster* and *better*, and at a *material saving* in cost.

This New "3 in 1" Tool is sturdily built, easy to operate and a great improvement over the original Stanley "3 in 1", which was the first combination strapping tool ever put on the market.

Your own INDIVIDUAL BRAND of Nailless Strapping, bearing your Company Name, Trademark or Slogan in BRILLIANT COLORS, coupled with this time saving equipment, make possible the very highest efficiency in package reinforcement.

THE STANLEY WORKS

New York
100 Lafayette St.

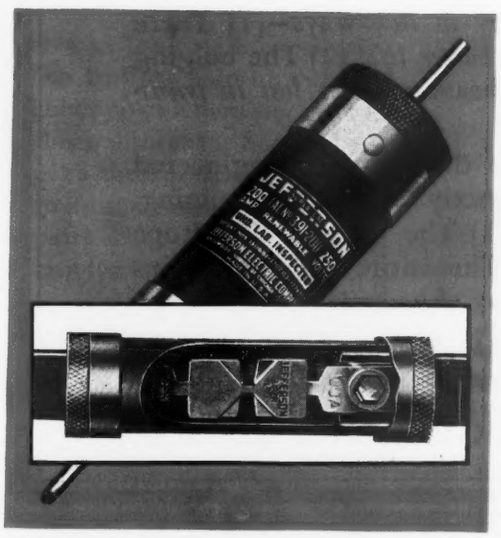
Box Strapping Division
New Britain, Conn.

Chicago
62 W. Kinzie St.

STANLEY EVERSAFE (Round Safety Edges) Japanned Nailless Strapping furnished in all standard widths and gauges.

DUPONT FOR BETTER PICTURES

Illustration of Colorgraph Strapping, which can be finished in any design and almost any color combination.



The secret of Jefferson Super-Lag performance lies in the lag plate which is a part of the Super-Lag link. This plate delays the normal fuse action, provides a time interval or lag. This time-lag prevents the fuse from blowing on harmless temporary overloads — saves needless shutdowns and link replacements.

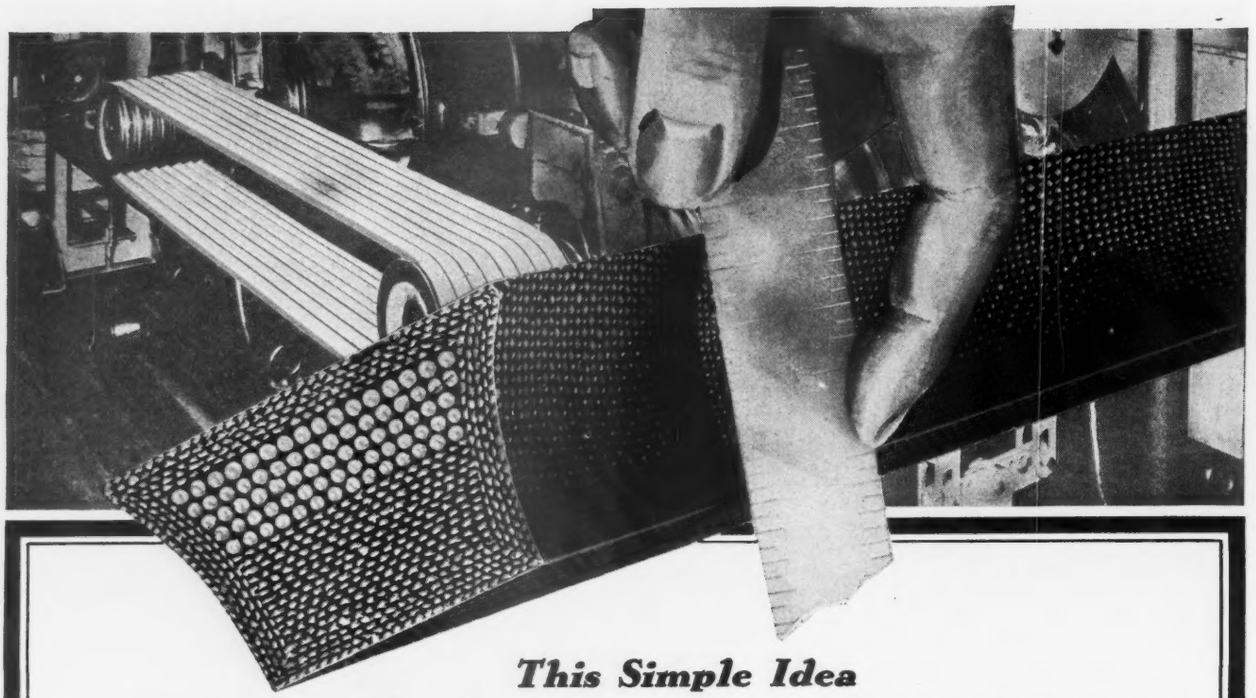
Part of every factory is STOPPED every week. Some of the lost time is necessary but too much of it is needless, for there are fuses which protect TIME as well as motors.

Jefferson Super-Lag Renewable Fuses protect time. They provide reliable *accurate* protection—riding over harmless, momentary surges, operating positively on extended, dangerous overloads. There is no better protection for electrical equipment and property—and with them your time.

The percentage of needless stops will decrease radically when you standardize on Jefferson Super-Lags. Made in all capacities—knife blade and ferrule types. Order them today.

JEFFERSON ELECTRIC COMPANY
BELLWOOD (Suburb of Chicago) ILLINOIS

JEFFERSON
Super-Lag RENEWABLE **FUSES**



This Simple Idea

SAVES Your Transmission DOLLARS

If you use V-belts make this interesting test: Pick up a V-belt having the ordinary straight side and *bend* the belt. Three things will happen, right before your eyes.

(1) The top of the belt is under tension and grows *narrower.* (2) The bottom is under compression and becomes *wider.* (3) The sides of the belt *bulge out.* (Figure 1, at left).

This bulging of the straight-sided V-belt in its sheave-groove costs you money in *two* ways—(1) There is uneven wear at the bulge—*shorter life!* (2) The bulging side cannot evenly grip the sheave-wall—a *loss in transmission* efficiency!

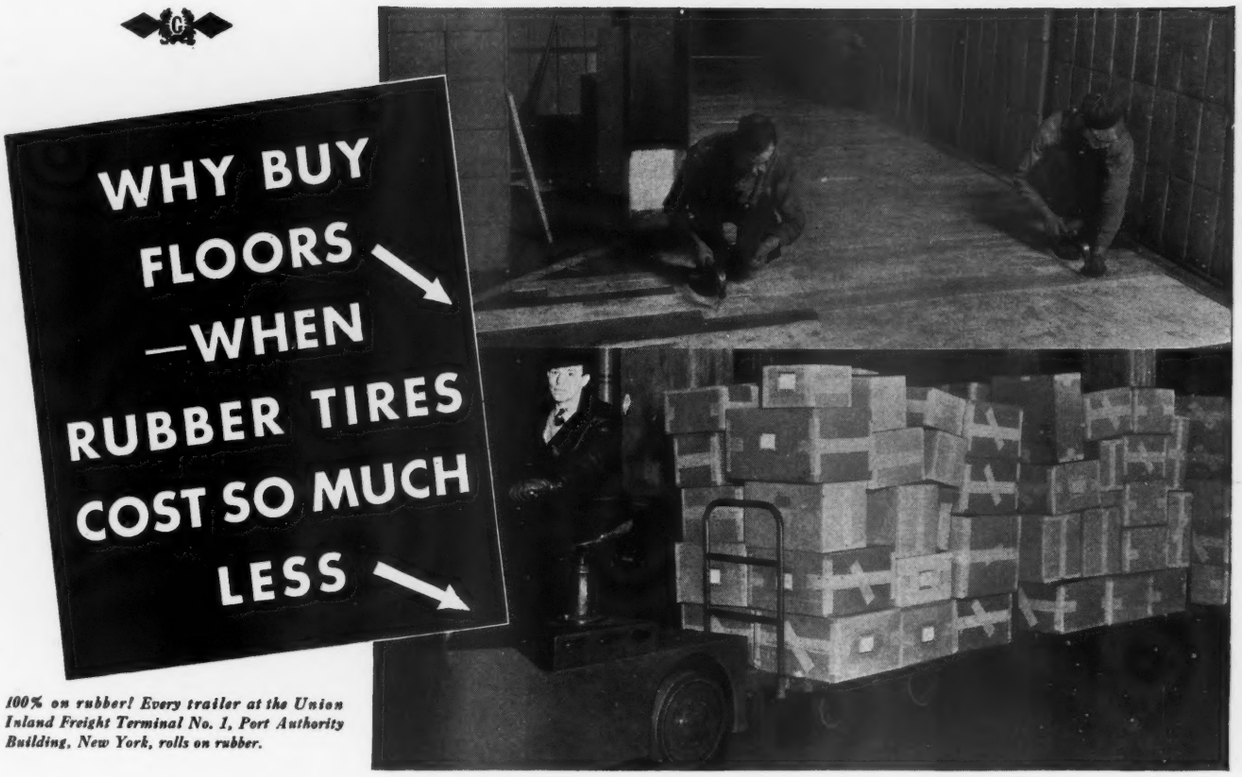
In figure 2, you see how the precisely engineered *concave* side (a Gates Patent) exactly corrects this bulging. Two distinct *savings* result. (1) The Gates Vulco Rope wears evenly—*longer life!* (2) The entire side-wall grips the pulley—no-slip—full *delivery of power!*

WRITE *for Valuable NEW Book on Transmission—FREE!*

Engineering service and stocks available in all large industrial centers

Manufactured by the GATES RUBBER CO., Denver, Colorado

GATES VULCO ROPE DRIVES



100% on rubber! Every trailer at the Union Inland Freight Terminal No. 1, Port Authority Building, New York, rolls on rubber.

Goodrich Tires Pay for Themselves in Floor Repairs Saved

Tests have proved it. Proved that most floors last ten to twenty times as long without repairs when trailers ride on rubber! Rubber gives where steel grinds. Rubber absorbs the bumps. Steel cracks the surface, knocks the corners and edges away. On floor repairs alone, you save enough to pay for this new type tire.

And power costs are less. New Goodrich tires roll 30% to 80% easier. Speeds are greater. Up to 29%.

Breakage claims drop. There's less noise, confusion. Lower depreciation.

You notice the difference from the first day. Savings start immediately. And remember, the difference in floor repairs alone pays the bill.

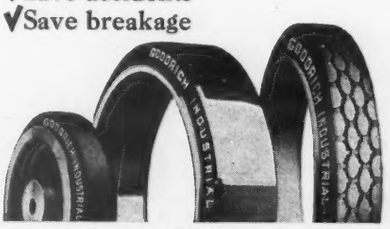
Actual tests proved the economy of rubber tires to the complete satisfaction of Union Inland Freight Terminal officials.

Tires for Any Trailer or Tractor

Why not get all the facts? Write for information or ask to have a Goodrich engineer study your equipment, outline the cash savings, make recommendations. Address Dept. N-54, The B. F. Goodrich Rubber Co., Akron, O.

"Let me cut costs in this way" . . .

- ✓Save floors
- ✓Save power and human energy
- ✓Save depreciation of equipment
- ✓End noise—vibration—save nerves
- ✓Save time
- ✓Save accidents
- ✓Save breakage



Goodrich *Industrial* Tires

QUESTIONS and ANSWERS

Conducted by G. A. VAN BRUNT

Why This Commutator Connection?

I notice that the commutator segments of a Delco model 3277, ½-hp., 110/220-volt, 1,765-r.p.m., repulsion-induction motor are each cross-connected to a segment directly opposite, or 180 deg. around the commutator. Will some reader give me the reason for this method of connection? What would be the effect on the performance of the motor if these cross-connections were left out when the motor is rewound?

L.W.—Cape Girardeau, Mo.

THE CONNECTIONS apply to many small motors. The purpose of having the diametrically opposite commutator segments connected by equalizing jumpers is to eliminate all the brushes and brush holders except one pair. For example, a four-pole wave-wound armature requires only two brushes, whereas a four-pole lap-wound armature requires four brushes. By placing equalizing jumpers on the commutator of the latter armature, however, the brush requirements would change from four to two. The armature in this type of motor would overheat if the equalizing jumpers were left off.

H. W. FISHER
Manchester, Conn.

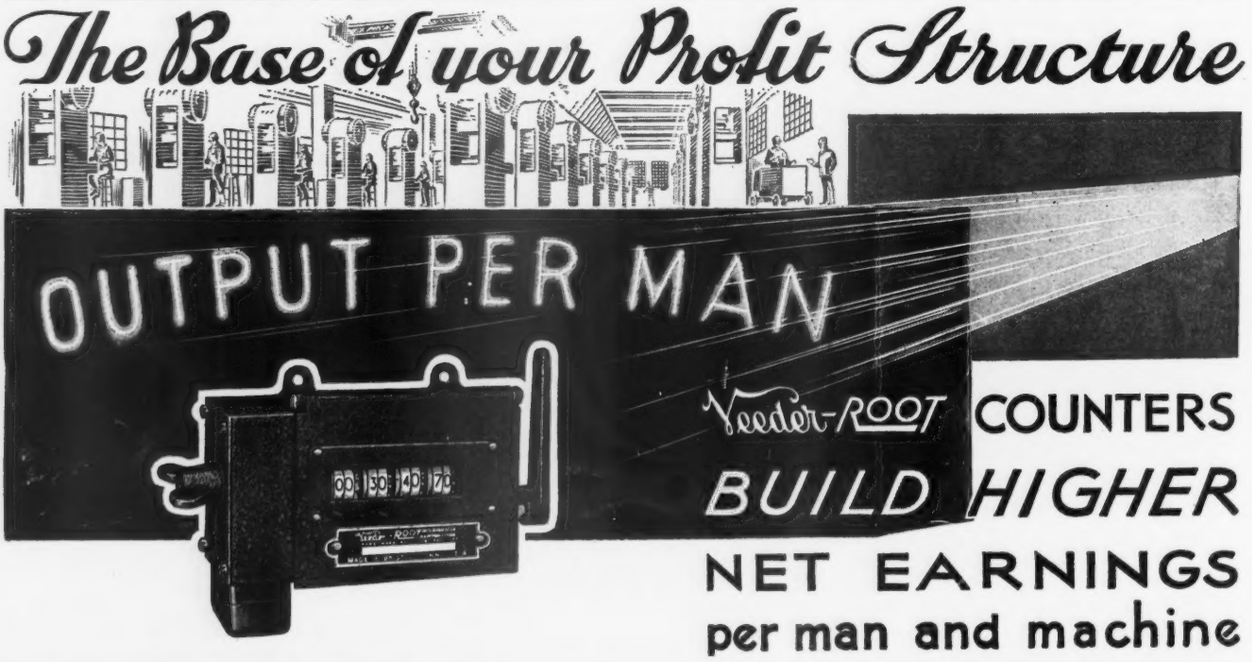
THESE are equalizer connections. They are not entirely essential, for many machines operate satisfactorily without them, but they add a factor of safety. Should the armature for any reason not be properly centered between the polepieces of a multipole machine, the flux density in the air gaps will be different and the voltage generated in the groups of coils in the larger air gaps will be less than that for the coils in the smaller air gaps, where the flux will be more dense. This unequal potential in different parts of the armature will cause circulating currents between the different groups of brushes, causing sparking and other bad effects unless means are provided to take care of this condition. These circulating currents cannot be prevented from flowing in the windings, but they can be partly prevented from flowing between the different groups of brushes by the use of equalizer connections.

These connections are sometimes put on the back of the winding, or back of the commutator risers, and connect points of the winding theoretically at the same potential. The armature will be completely equalized if all the segments on the commutator that are at the same potential are connected together. In a four-pole machine, commutator segments that are exactly 180 mechanical degrees apart are theoretically at the same potential.

M. V. MILLER
Indianapolis, Ind.

Floor Cold, Ceiling Hot

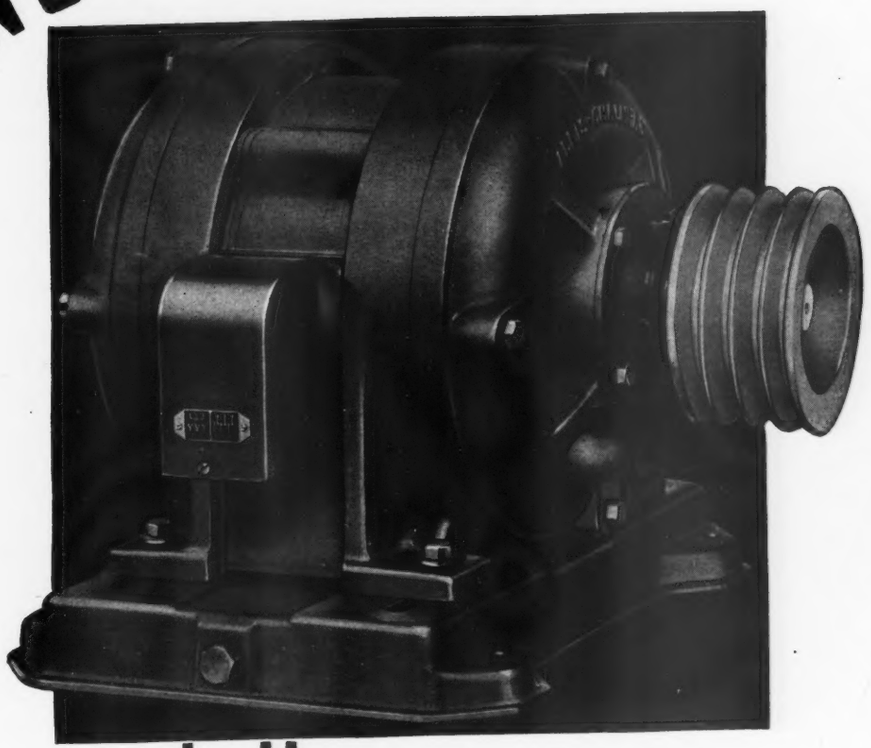
The wall-type radiators in some of our departments were mounted



BASE YOUR MANAGEMENT of men and machines on exact records of what *each one* DOES. Too little production from certain units lets down profits on the others — and too little production *shows up at once* on the dials of Veeder-Root Counters. Automatically you get the records; immediately you can apply the remedy. . . Veeder-Root can apply the COUNTERS to practically any production machinery. Tell us where you need the check-up; recommendations will follow without obligation. » » »

VEEDER-ROOT INCORPORATED
HARTFORD, CONNECTICUT.

ANNOUNCING



THE full measure MOTOR

★ Designed for mechanical strength and endurance, wherever electric power is used.
★ Its durability is measured by service on hard jobs.
★ The latest features of electrical design are embodied in its construction.

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Allis-Chalmers Manufacturing Company, Milwaukee

IT TAKES A Quincy Compressor TO GIVE Quincy Performance

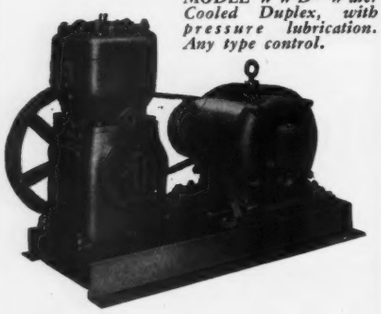
It's no accident that Quincy Compressors are providing dependable, low-cost performance in various types of regular, intermittent, or standby service—under conditions that require instant and unfailing response to operating demands. It's the result of mechanical excellence designed and built in — plus correct application recommended by Quincy Air Engineers.

Before You Buy

INVESTIGATE—Quincy Compressor Features

ASK ABOUT—Quincy Air Engineering Service

MODEL WWD—Water Cooled Duplex, with pressure lubrication. Any type control.



MODEL WWC — Water Cooled Duplex, with pressure lubrication. Completely automatic including all controls.

QUINCY COMPRESSOR CO.
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205 W. Wacker Drive, Chicago, Illinois
30 Church Street, New York, New York

QUINCY Compressors

about 2 ft. below the ceiling, which is 12 ft. high. The departments are 125 ft. long and 60 ft. wide. In cold weather the temperature for about 2 ft. above the floor is much too low for comfort, although the air within a few feet of the ceiling is hot. To relocate the radiators close to the floor would cost considerable; furthermore, we should like to keep the walls clear, if possible. What would be the cheapest and most satisfactory way of securing a reasonably uniform temperature from floor to ceiling?

G.B.—Boston, Mass.

THIS condition is due to insufficient air circulation. The air nearest the radiator becomes heated and remains close to the ceiling. It is necessary to move this air down closer to the floor where it is actually required. I suggest that G. B. install several motor-driven fans of 18- to 24-in. diameter to provide for air circulation. Possibly 16-in. oscillating fans might be more desirable, since they would also add comfort during the summer.

Fans would be the most economical method of overcoming the condition and they would not disturb the present radiator installation. Eight or ten of these oscillating fans evenly distributed in the room just below the present radiator plane should bring about the desired result. Tilting and oscillating angles will be a matter of experience.

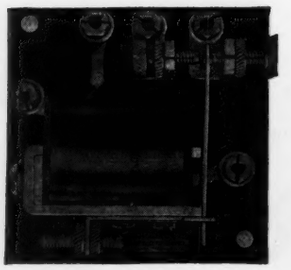
F. C. RAGG, *Glen Rock, N. J.*

Instruments Needed by Maintenance Department

I wish that other readers would give me a list of the electrical and mechanical instruments and testing devices which they think are necessary for our maintenance department to have in inspecting equipment and diagnosing troubles. We operate a wood- and metal-working plant containing about 450 motors, mostly three-phase a.c., fractional to 50 hp., with twenty 10- to 25-hp. d.c. motors. Sixty per cent of our machines are driven from line shafts, with the remainder on individual motor drives. Power is purchased, but we have a boiler plant for heating and process steam, which contains several pumps and two air compressors. We do most of our own rewinding.

M.R.E.—St. Louis, Mo.

I SUGGEST a line of load-testing instruments as follows: One d.c. voltmeter. One d.c. ammeter, preferably graphic, with sufficient shunts of the correct values to give two-thirds or three-quarter scale readings on the meter. One a.c. voltmeter suitable for voltages of the plant lighting and power circuits. Two a.c. ammeters, provided with variable-ratio current transformers



Work out your Own Photo Cell Applications

There are many ways that you can use photo cell control in your plant. You can buy a matched photo cell and relay for $7.50 . . . to work out applications on a practical basis that will save money in your plant. Send for Bulletin P-1 on Photo Cell Circuits and applications.

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Reliability Durability Economy

VEELOS BALATA BELTING

Pure Balata Gum does not deteriorate with age, and under our process of manufacture, Veelos Balta Belting is the most reliable and durable obtainable. On account of its long life and of the fact that it requires practically no care or attention, no stoppages or breakdowns interfere with your production. This saving will soon pay you the cost of the belt many times over. Veelos Balata Belting is by far the most economical belting on a service basis.

MANHEIM MANUFACTURING AND BELTING CO.
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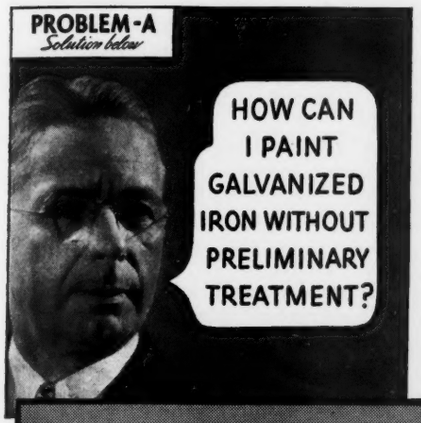
Answers To Paint Questions

By One of America's Largest Manufacturers of Industrial Paints



HERE ARE THE SOLUTIONS

PROBLEM A—Almost everyone has had trouble with paints peeling from newly galvanized surfaces. Ordinary paints lack those adhering qualities which are necessary to overcome the surface accumulations resulting from the processing of galvanized iron. Cemtex, the Degraco cement base paint, does have those essential qualities. Thousands of industrial buyers have eliminated this industrial painting problem by using Cemtex as prime coat on painted galvanized surfaces.

PROBLEM B—Idle machinery makes no profit. Particularly today when constant use of all equipment is necessary for economical operation, it is difficult to find time for protective measures. It is possible however to keep motors, generators, turbines, presses, etc., protected and in good appearance by using Degraco "Fast Dry Machinery Enamels." Applied when power is shut off at night, or early in the morning, these heat and oil proof finishes dry in from 2 to 4 hours. The finish is bright, durable and lasting.

PROBLEM C—Perhaps you don't realize that TIME is a part of your painting cost—⅔ of the cost in most cases. Degraco's Wall Gard system cuts the time element in half without sacrificing one bit of quality and suitability. Because Wall Gard primer is lime proof it may be applied on new plaster as well as old—a time saver when patching or new partitions are necessary. Wall Gard Finish may be applied the same day when necessary, tying up space for the shortest possible time. And Wall Gard is washable, too, making repainting less frequent. Aren't these savings worth considering?

DEGRACO PAINTS VARNISHES ENAMELS

SPECIAL FREE SERVICE ON ALL PAINT PROBLEMS GIVEN BY DEGRACO

MANY of America's leading industrial concerns have found an astonishingly simple, easy way to solve all of their painting problems. They say, "this method saves time, ends guesswork, cuts costs as much as in half." It makes every plant maintenance man, every paint buyer an expert at picking the correct paint for every job, big or little, indoor or outdoor.

This modern type of paint information service has been developed by one of the nation's leading paint manufacturers, a company that specializes exclusively on industrial paints. No matter how much or how little you may know about paint, the Degraco plan saves you time and trouble. It puts before you the exact facts required to solve any problem in the most practical way. With these facts you can select any type or make of paint without doubt, question or delay. The coupon below brings details of this modern paint-buying system plus the new Degraco "Easy-Way" paint chart that shows the best type and grade of paint to use for every purpose.

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Detroit, Michigan

FREE OFFER . . . MAIL NOW

DETROIT GRAPHITE COMPANY
532 Twelfth Street, DETROIT, MICH.

Please send me without cost or obligation one of your "Easy-Way" paint charts, also facts about Degraco service to industrial paint buyers. (Enclose letter with question about any special painting problem if you care to.)

*Name*_____

*Company*_____

*Town*_____ *State*_____

Size, 3¼" diameter, made for either flush or surface mounting, single or double contact . . .

Scale may be calibrated for current, voltage, temperature, etc. . .

THE WESTON *Supersensitive* CONTACT-MAKING INDICATOR

. . . low operating values . . . high contact capacity . . . contacts made and held magnetically

Here is a sensitive relay that will make contact on values down to three microamperes or one millivolt, with contacts capable of handling five watts at 110 volts, non-inductive load. It's the new Weston Model 705 . . . the first relay of such sensitivity ever produced capable of handling this amount of energy on its contacts.

And Model 705 employs a radically new principle of contact-making. A few microamperes swing the moving contact into the field of the permanent magnet stationary contact which pulls the moving contact in positively and holds it tight until contact is broken manually or automatically.

Model 705 greatly broadens the field of application for sensitive relays and simplifies many existing problems. It permits of control by means of small electrical quantities such as are generated by photo-electric cells, thermo-couples, etc. It has been found ideal for alarm and protective systems, smoke-detection devices, paper-break detectors, etc., as well as for temperature control.

Complete information on Model 705 and other Weston relays is available and will gladly be sent on request. Weston Electrical Instrument Corporation, 628 Frelinghuysen Avenue, Newark, New Jersey.

WESTON *Instruments*

of the core type, preferably the hinged variety. Two single-phase wattmeters or one polyphase wattmeter, probably the polyphase would be the more suitable. This instrument should be a graphic one so that records for long periods of time may be available for study. A portable power factor instrument would be useful but not essential as the power factor of the motors can be readily determined from the readings of the wattmeter and the ammeters with the voltmeter readings.

A good tachometer is important because it is essential to know speeds accurately. Direct-reading instruments are on the market. An ordinary speed indicator can be used in conjunction with a stop watch.

A good insulation tester, this a 600-volt instrument unless the motor circuits and motors carry above 2,500 volts. A complete insulation survey of all the equipment in the plant could be made and the results recorded on suitable cards which should be filed for future reference and tests. This test should be made at least twice a year, at shorter intervals if much of the equipment is subjected to moisture or acid conditions.

Another instrument extremely valuable for resistance tests is a low-resistance testing set, direct reading from a few ohms down to one microhm. It is adapted to testing resistance of contacts, armature windings, soldered joints, and wherever heating may occur.

Some good thermometers with Centigrade scales will prove useful in determination of safe operating temperatures of such equipment as overloaded motors and transformers.

These instruments can be arranged on a table mounted on rubber tired wheels and can be supplied with cables, switches and wires of suitable lengths and capacities so that when a test of any piece of equipment is desired all the instruments are ready and can be wheeled to the job.

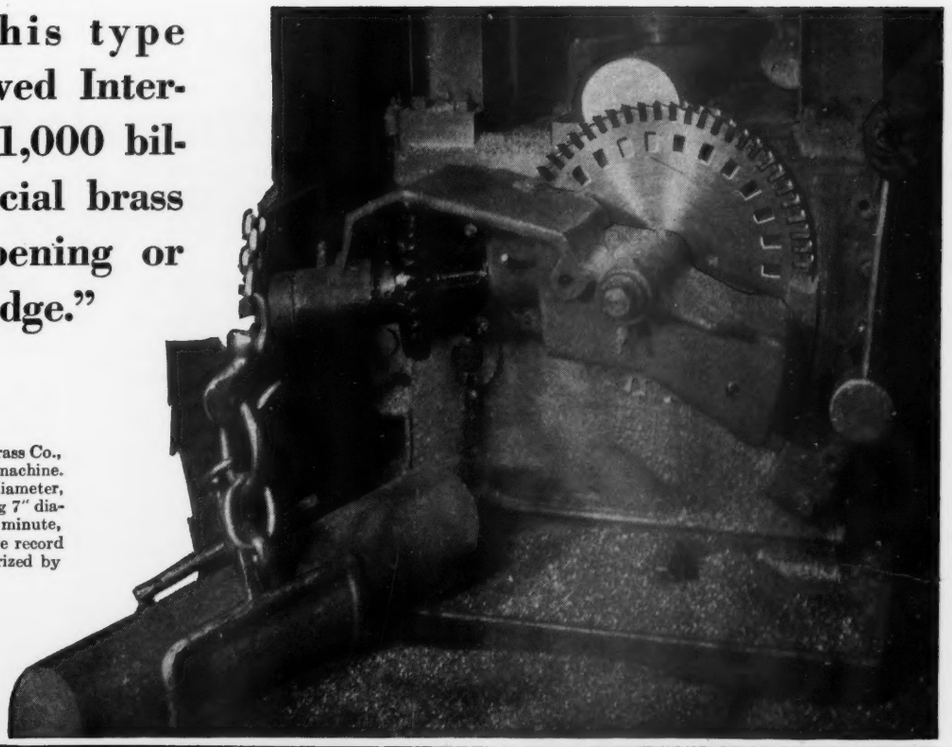
LEE F. DANN
Mica Mine, P. Q., Canada

ANSWERS WANTED

Does It Pay to Overbelt?

I presume that using a heavier belt than is required according to belting tables to carry a given load will result in longer life and possibly better service, but I should like to know whether in general these advantages are sufficiently marked to justify the extra cost. For example, a table which I use recommends a 7-in., light-double leather belt on a 20-hp., 1,200 r.p.m. drive, with a 9-in. diameter motor pulley. Assuming that this is an ordinary drive, with no unusual load conditions, would there be any

"...saw of this type (Disston Improved Interlock) has cut 11,000 billets of commercial brass without resharpening or tightening a wedge."



Photograph taken at Plant of Mueller Brass Co., Port Huron, Mich. No. 17 Higley machine. Disston Improved Interlock Saw, 21" diameter, 58 teeth, 9/64" blade, 3/16" kerf. Cutting 7" diameter brass billets, 22 revolutions per minute, one billet every 55 seconds. Remarkable record quoted above is from statement authorized by J. R. Wightman, of Mueller Brass Co.

DISSTON

Improved INTERLOCK INSERTED-TOOTH METAL-CUTTING SAW

Specially treated Disston Alloy Steel produces a blade that withstands severe feed pressure. Teeth are Disston High-Speed Steel. They stay aligned, cut fast, give long service.

HACK SAW BLADES . . . Disston heat treatment means uniform structure that gives more work per blade; more cutting per hour.

METAL-CUTTING BAND SAWS . . . Disston steel and heat-treating methods produce a metal-cutting band with hardness *alike* in each tooth.

DISSTON FILES . . . Disston, one of the largest consumers of files—for filing saws, and other cutting purposes—makes files for all industrial uses with the quality you must have for the service you want.

METAL-SLITTING SAWS . . . Made of Disston Carbon or High-Speed Steel carefully heat-treated, accurately hollow-ground and finished, assuring utmost accuracy.

Henry Disston & Sons, Inc.

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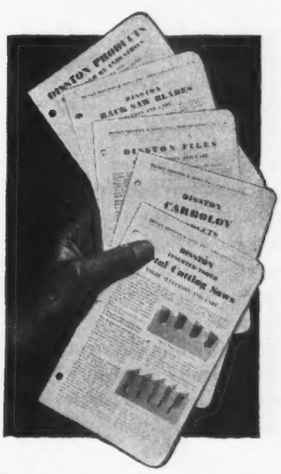
FREE to you...

Any one or all of these

DISSTON METAL-CUTTING MANUALS



To:
HENRY DISSTON & SONS, Inc.
524 Tacony, Philadelphia, U. S. A.

I'll be interested in having your tabloid data on metal-cutting tools for modern industrial processes. Send manuals checked.

- ☐ Inserted-Tooth Metal Saws
- ☐ Disston Carboloy Products
- ☐ DISSTON FILES
- ☐ HACK SAWS
- ☐ Disston Metal-Cutting Band Saws
- ☐ Disston Products Indexed for Industries

*Attention of*_____

*Firm Name*_____

*Address*_____

PLANT AND EMPLOYEES... BOTH SAFE!

Cyclone Fence is your TROUBLE STOPPER!

Statistics prove that millions of dollars are lost yearly by riots, strikes, pilferage, fires, careless trespassers, personal injury liabilities to uninvited visitors. They are all unimportant troubles until they happen to us and we find that one of them has cost us more than a CYCLONE *Property Protection* FENCE.

An accurate estimate or a catalog containing complete information concerning the high quality materials and the superior features of the most economical Cyclone Fence for your property will be furnished on request. Information will also be furnished regarding Cyclone's 47 years of experience in solving all kinds of fence problems, and the exceptionally satisfactory results of our own erection crews. Write for catalog today. Address Dept. F.M.

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Cyclone Fence Company
General Offices: Waukegan, Illinois
SUBSIDIARY OF UNITED STATES STEEL CORPORATION
BRANCHES IN PRINCIPAL CITIES
Pacific Coast Division:
Standard Fence Company
Oakland, Cal.
Cyclone—not a "type" of fence, but fence made exclusively by Cyclone Fence Company and identified by this trade-mark.

justification for using a wider or thicker belt? Conversely, would there likely be marked shortening of life or more trouble if a belt say 1 in. narrower than called for were used. How much factor of safety is allowed in the belt tables put out by the different manufacturers?

C.S.G.—Atlanta, Ga.

Trouble in Operating Generators in Parallel

We are having trouble in getting two 150-kw., compound-wound, interpole generators to operate in parallel. They are directly driven by 436-hp., 2,200-volt synchronous motors. Generators and motors in both units are of the same make, size, speed, and so on, and both motors are supplied from the same line. Both generators are flat compounded and give the same voltage at the same loads, but when they are running in parallel one generator will gradually take on more and more load until the breakers trip. The next time the load comes on it may be taken up by the other generator. In other words one generator does not consistently carry more load than the other. The equalizer wire and buses are almost as large as the main leads; so I assume that they are of ample size. Can someone tell me why the generators will not run properly in parallel, and how to remedy the situation?

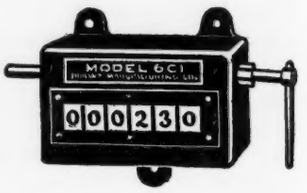
F.D.—North Hollywood, Calif.

Who Will Tell Me About Record-Card Containers?

We should like to have information as to where and how practice similar to that outlined in the following paragraph has been carried out. We want to know what designs have been worked out by other readers and/or where the containers referred to can be purchased as a standard product:

Container for test and record card or tag to be used in connection with new type valves, traps, fittings, switches, etc., that are installed for actual service in factory operation, and performance of which shall be followed up. Container to be suspended on the part under test, to be waterproof, heat-proof (steam) and fairly unbreakable; shall contain a small window made of glass or other transparent material so that the main section of card can be read from the outside. Maintenance men shall record on such card whenever repairs, etc., are made and turn it in to engineering office on date requested on tag.

H.W.S.—Binghamton, N. Y.



Detecting the Waste

The first step in eliminating waste of materials is to find it.

Unsuspected large spoilage and losses are often brought to light when *Productimeters* (mechanical counters) are placed on key machines in a manufacturing process. A comparison of readings tells how much is missing and where last seen.

Productimeters will count or measure a large variety of products with much greater speed and accuracy than by hand. Tell us what you want to keep track of.

DURANT MFG. CO.
1918 N. Buffum St.
Milwaukee, Wis.

Productimeters
THE SPEEDOMETERS OF INDUSTRY

SPRAYIT
EASILY PORTABLE

MODEL 90

A highly efficient Spray outfit developed and perfected by the originators of Portable Spray Painting Equipment.

Used successfully as a production tool in many plants, for maintenance work in others. Can be carried to the job either inside or out.

Operates off any light socket. Sturdy ¼ HP motor direct connected to rotary compressor. Fan or round spray. Exceptional price. Will quickly pay for itself. Last for years.

Write for folder on other Sprayits, Air Line Guns, Vacuum Pumps, Air Compressors and accessories. Kindly specify item in which interested.

THE ELECTRIC SPRAYIT CO.
South Bend, Indiana

Today's PROFITS must come from...

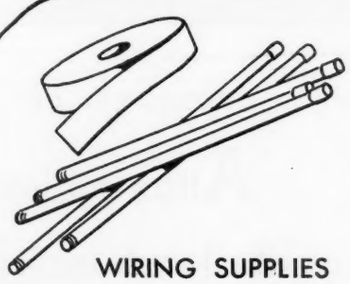
~~Low materials costs~~

~~Low labor costs~~

Efficiency

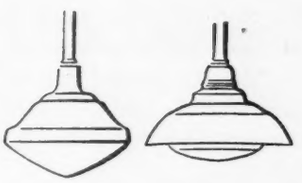
Every indication points to still higher labor and materials costs. Efficiency in production has become the key to profits. One way to increase efficiency is to bring your electrical installation up-to-date. Great forward strides have been made in recent years. Your present layout may be obsolete. Let us advise you on recent developments. Write us—or ask our salesman.

EFFICIENCY BUILDERS

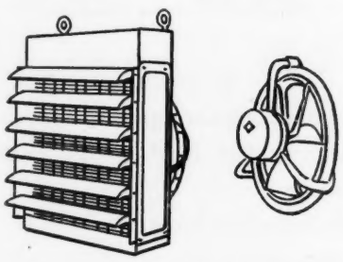


WIRING SUPPLIES

MOTORS AND CONTROL



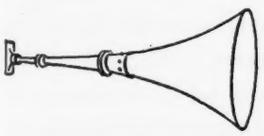
LAMPS AND LIGHTING



VENTILATING FANS AND UNIT HEATERS

WIRE AND CABLE

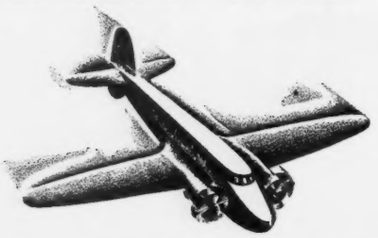
SIGNALLING DEVICES



WESTERN ELECTRIC SOUND SYSTEMS

TOOLS

NEW GIANT AIR LINER SPEEDS UP TRAVEL



NEW SUPER-LUX FIRE EXTINGUISHER KILLS FLAMES QUICKER

SPEED in travel is desirable. But when flames menace your plant, fast fire extinguishing is a necessity. The new Super-LUX extinguisher smashes all records of fire extinguishing speed and efficiency.

33% greater extinguishing agent capacity without any increase in weight gives the Super-LUX extinguisher exceptional flame-killing power. It puts out more fire in gasoline, oil, lacquer, and solvents than any other device of comparable size. It puts out fires in gasoline or solvents running from a leaking pipe or tank against which other types of extinguishers fail.

Every second fire burns in your plant, adds to the fire loss and production delay. May we demonstrate to you the remarkable extinguishing speed that the new Super-LUX unit offers? Walter Kidde & Company, Inc., Dept. C-6, Bloomfield, New Jersey.

For Fires in Oil, Gasoline, Lacquer, Alcohol, Solvents and Fires in Electrical Apparatus
LUX CARBON DIOXIDE FIRE EXTINGUISHERS

(Continued from editorial page 242)

describes "everything needed for small heating jobs."—General Electric Co., Schenectady, N. Y.

FURNACES—Leaflet TD-20, "Trent Electric Furnaces." Pot and trough types.—Harold E. Trent Co., 618 N. 54th St., Philadelphia, Pa.

FURNACES—Bulletin No. 26, "Standard Large Oven Furnaces." Bulletin No. 27, "Pot Furnaces." Bulletin No. 28, "Small Oven Furnaces for Tool Steel, Annealing, Pre-Heating, and Drawing." — Standard Fuel Engineering Co., 667 Post Ave., South, Detroit, Mich.

GAS CUTTING—Booklet, 92 pages, "Machine Gas Cutting . . . The Key to Better Design, Faster Production, Sweeping Economies . . ." — Air Reduction Sales Co., 60 E. 42nd St., New York.

GEARS — Catalog, 448 pages. Complete lists of all types of gears, 108 pages of gear engineering, horsepower ratings, tooth loads for each gear listed, hob list, speed reducer engineering section. — The Horsburgh & Scott Co., 5114 Hamilton Ave., Cleveland.

IDLERS — Folder, "Bulk Handling by Belt." Illustrates applications of Rex-Sterns Timken Idlers.—Chain Belt Co., Milwaukee, Wis.

MAGNESIUM ALLOY — "Dowmetal Data Book," 68 pages, gives fabrication data, design, and finishing information.—Dowmetal Division, The Dow Chemical Co., Midland, Mich.

METERS — Booklet, "Solving Industrial Crimes, Case No. 1." Illustrates and describes various controlling and recording instruments. — The Esterline-Angus Co., Indianapolis, Ind.

MOTORS—Leaflet L.20613, "Quiet Operating Motors." Describes method of individual testing of motors for quietness, distinctive features, construction, application, and control.—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS—"The Louis Allis Messenger" for March and April. Devoted to Louis Allis motors and products.—The Louis Allis Co., Milwaukee, Wis.

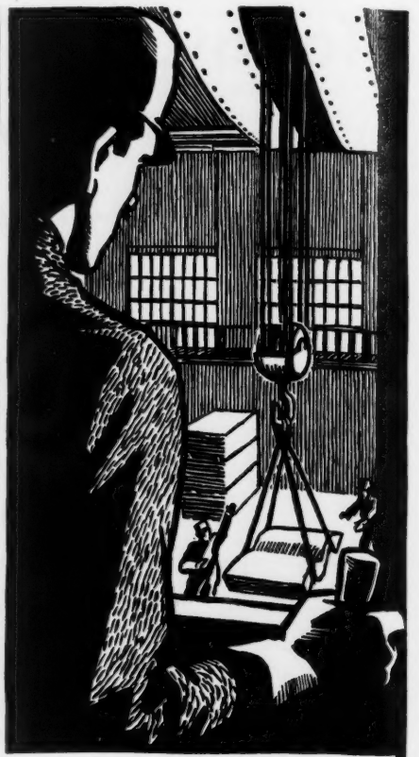
MOTOR DRIVES — Leaflet, "Synchronous Motor Drives for Pulp and Paper Mills." —Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTOR GENERATORS—Bulletin No. 1155, "Motor Generator Sets."—Allis-Chalmers Mfg. Co., Milwaukee, Wis.

PIPE—Bulletin TR-6-A, "Transite Pressure Pipe Ends Tuberculation, Soil Corrosion, Electrolysis."—Johns-Manville, 22 E. 40th St., New York.

POLISHES, SPRAYS — Catalog, 12 pages, deals with emulsions, waxes, resins, new chemical products, odorizing materials, water soluble resins, etc.—Glyco Products Co., Inc., Bush Terminal Building No. 5, Brooklyn, N. Y.

RESPIRATOR — Bulletin No. S-68, Describes Sly "Purair" helmet, including pressure reducer, air filter, purifier.—The W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland.



CRANE OPERATORS SAY:

"Atlas slings handle loads safer ... easier ... faster"

● **Macwhyte Atlas Braided Slings are quickly applied and hug the load, preventing slippage.**

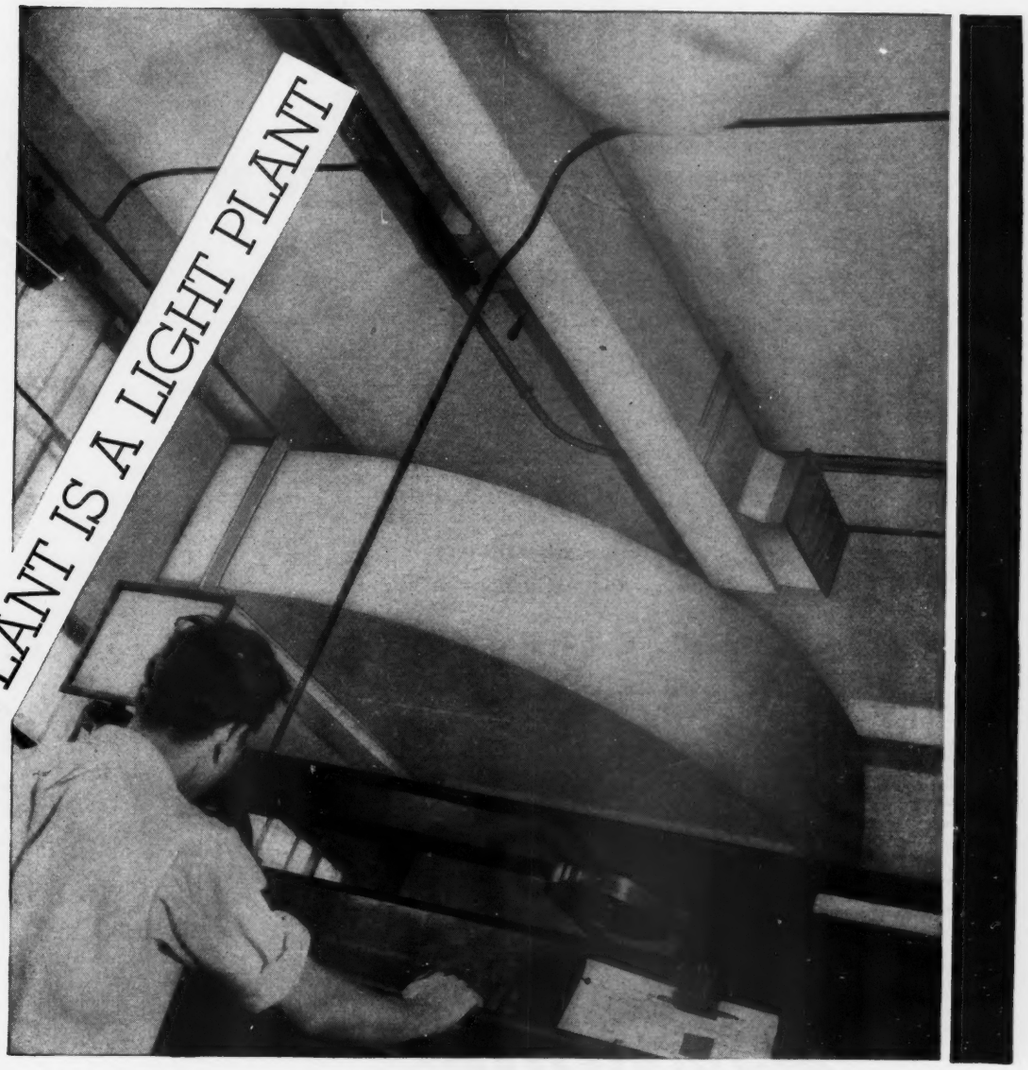
• **Because they have a flexible non-kinking body made of multiple parts of wire rope, Atlas Slings are easier to handle and are unusually safe.**

• **Macwhyte Atlas (patented) Braided Slings are made exclusively by the makers of Macwhyte Wire Rope. Write for performance records, complete data and catalog.**

Macwhyte Company • Kenosha, Wisconsin

ADV. NO. 129

MACWHYTE ATLAS *Slings*



MEN CAN SEE BETTER . . .

in this plant . . . since it has been given a fresh coat of white paint . . . and the accuracy of manufacture has been improved.

White paints of high light reflection are a valuable asset to plant management. Clean white walls and ceilings provide that added illumination so necessary to efficient workmanship—safety—sanitation—and better working conditions.

To maintain a high light reflection value of walls and ceilings . . . permanent whiteness is essential in the paint you select. Your favorite paint manufacturer can supply you with paint, based on permanently white Zinc Sulphide Pigments. Such paint is not discolored by common industrial gases. Its exceptional smoothness of film keeps dust and dirt accumulation to a minimum. A Zinc Sulphide Pigment paint film is also tough and durable and is unaffected by periodic washings.

We shall be glad to tell you more about the light reflection value of Zinc Sulphide Pigment paints.

Send for the booklet, "Using Paint as Light"

THE NEW JERSEY ZINC COMPANY, 160 FRONT STREET, NEW YORK

The New Jersey Zinc Company supplies to paint manufacturers Zinc Sulphide Pigments in three strengths ("XX" ZINC SULPHIDE—"CRYPTONE"—"ALBALITH" LITHOPONE) to give high grade interior and exterior paints the desired degree of color, hiding power and durability, depending on the requirements.

New Jersey zinc® ZINC SULPHIDE PIGMENTS IN PAINT

THE BRUSH MAKER'S CONTRIBUTION TOWARD PERFECTION

- Absolute Control of Ingredients
- Careful Processing to Insure Uniformity
- Close Tolerances, Electrically and Mechanically
- Accurate Assembly of Shunts and Fittings
- Particular Study of Machine Characteristics and other Factors Influencing Brush Performance

These are the inherent features of every Ohio Carbon Brush.

THE OHIO CARBON COMPANY
12508 BEREA ROAD CLEVELAND, OHIO

install
FENCE

STOP TRESPASSING!

Stewart Non-climbable Chain Link Wire Fence says "stay out" —and means it! Trouble-makers lose their entree when Fence is installed. Stewart Fences are of copper-bearing steel Fabric, galvanized AFTER WOVEN. Available with tubular or heavier open section I-Beam framework—galvanized after fabrication.

Let us quote on your requirements.

The STEWART IRON WORKS COMPANY, *Inc.*
209 Stewart Block — Cincinnati, Ohio

RHEOSTATS — Catalog 1370, "'Jagabi' Rheostats for Fine Adjustment and Control of Electric Current."—James G. Biddle Co., 1211 Arch St., Philadelphia, Pa.

SAW — Booklet, "Cutting Metals with the Wells Band Saw."—The Wells Mfg. Co., Three Rivers, Mich.

SCALES—Condensed Catalog No. 7, data on various types of industrial dial scales. —The Kron Co., Bridgeport, Conn.

SHAFTING — Booklet, describes various grades of shafting available. — Union Drawn Steel Co., Massillon, Ohio.

STEEL—Bulletin, "Cromovan Triple Die Steel for High Production."—Firth-Sterling Steel Co., McKeesport, Pa.

WRENCHES — Catalog No. 34A. Illustrates, describes complete lines of open-end, box, socket, pipe, and special wrenches for hand or power use.—Bonney Forge and Tool Works, Allentown, Pa.

BOOKS

NATIONAL ELECTRICAL CODE HANDBOOK

Arthur L. Abbott, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. 523 pages. Appendix. Index. Figures. Diagrams. Tables. $3.

Second edition. Based on 1933 edition of national electrical code. Divided into five parts dealing with definitions, types of wiring approved under given conditions; materials and apparatus and their installation, general requirements, and special cases.

On the Calendar

MAY

14-17, National Fire Protection Association, annual meeting, Atlantic City, N. J. Franklin H. Wentworth, Managing Director, 60 Batterymarch St., Boston, Mass.

JUNE

17-22, Society of Automotive Engineers, summer meeting, Saranac Inn, N. Y. John A. C. Warner, General Manager, 29 West 39th St., New York.

18-21, National Association of Purchasing Agents, annual convention and Inform-A-Show, Cleveland. Ralph G. Sweeney, General Convention Committee Chairman, Allyne-Ryan Foundry Co., Aetna Rd., & E. 91st St., Cleveland.

18-23, American Association for the Advancement of Science, summer meeting, Berkeley, Calif. Henry B. Ward, Permanent Secretary, Smithsonian Institution Bldg., Washington, D. C.

25-29, American Society for Testing Materials, annual meeting, Atlantic City, N. J. R. E. Hess, Assistant Secretary, 1315 Spruce St., Philadelphia, Pa.

25-28, National Association of Cost Accountants, annual convention, Cleveland. Stuart C. McLeod, Secretary, 1790 Broadway, New York.

25-28, American Society of Mechanical Engineers, semi-annual meeting, Denver, Colo. Calvin W. Rice, Secretary, 33 West 39th St., New York.

JULY

7-21, The Summer Institute for Social Progress, Wellesley College, Wellesley, Mass. M. B. Luitweiler, Chairman of Admissions Committee, Millburn, N. J.